1.0 INTRODUCTION

1.1 PURPOSE OF REPORT

The Tennessee Products (TP) Site, located in south Chattanooga, Tennessee, consists of a former coke production facility, its associated uncontrolled coal tar disposal areas, and approximately 2.5 miles of sediments in Chattanooga Creek that are all contaminated primarily with polycyclic aromatic hydrocarbons (PAHs). The site was placed on the National Priorities List (NPL) in January of 1994 based on an EPA multi-media study of Chattanooga Creek and on a Health Advisory issued by the Agency for Toxic Substances and Disease Registry (ATSDR) in 1993 concerning contact with the coal tar deposits[1]. Having been placed on the NPL, a remedial investigation and feasibility study (RI/FS) of the TP Site is thus required as promulgated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP).

The purpose of the RI/FS process is to gather enough information about the site to support an informed risk management decision regarding which remedy is the most appropriate for the site. The RI serves as the mechanism for collecting data to characterize site conditions, determine the nature and extent of the waste, assess risk to human health and the environment, and conduct treatability testing as necessary to evaluate the potential performance and cost of the treatment technologies being considered. The FS serves as the mechanism for development, screening, and detailed evaluation of alternative remedial actions. The various steps, or phases, of the RI/FS process are briefly described below:

- Scoping - the initial planning phase of the RI/FS, including the preliminary assessment and site investigation

[1] On November 12, 1996, the U.S. Court of Appeals for the D.C. Circuit, in Mead Corporation v. Browner (No.95-1610), removed the 24-acre former Coke Plant property from the Tennessee Products Site Superfund (NPL) listing. Consequently, the Tennessee Products NPL site consists only of 2.5 miles of Chattanooga Creek and its floodplain.

- Site Characterization - definition of the nature and extent of contamination, identification of applicable or relevant and appropriate requirements (ARARs), and development of the baseline risk assessment

- Development and Screening of Alternatives - identification of potential treatment technologies, screening of these technologies, assembly of the technologies into alternatives, and screening of the alternatives

- Detailed Analysis of Alternatives - further refinement of the alternatives, analysis of the alternatives with respect to nine evaluation criteria, and comparison of the alternatives against each other.

The RI and FS are conducted concurrently so that data collected in the RI influence the development of remedial alternatives in the FS, which in turn affects the data needs and scope of the treatability studies and any additional field investigations.

The purpose of this report is to document the results of the RI field investigation performed by CDM Federal Programs Corporation (CDM Federal) for the Tennessee Products Site, and provide the information needed to perform a human health risk assessment assessing the impacts of contamination at the site, and a feasibility study evaluating potential remediation alternatives, if necessary. This document is submitted to EPA in accordance with Work Assignment No. 064-4LBV under Contract No. 68-W9-0056. The human health risk assessment was completed and submitted to EPA as a separate document in February 1999 (CDM Federal, 1999).

1.2 SITE DESCRIPTION

1.2.1 LOCATION

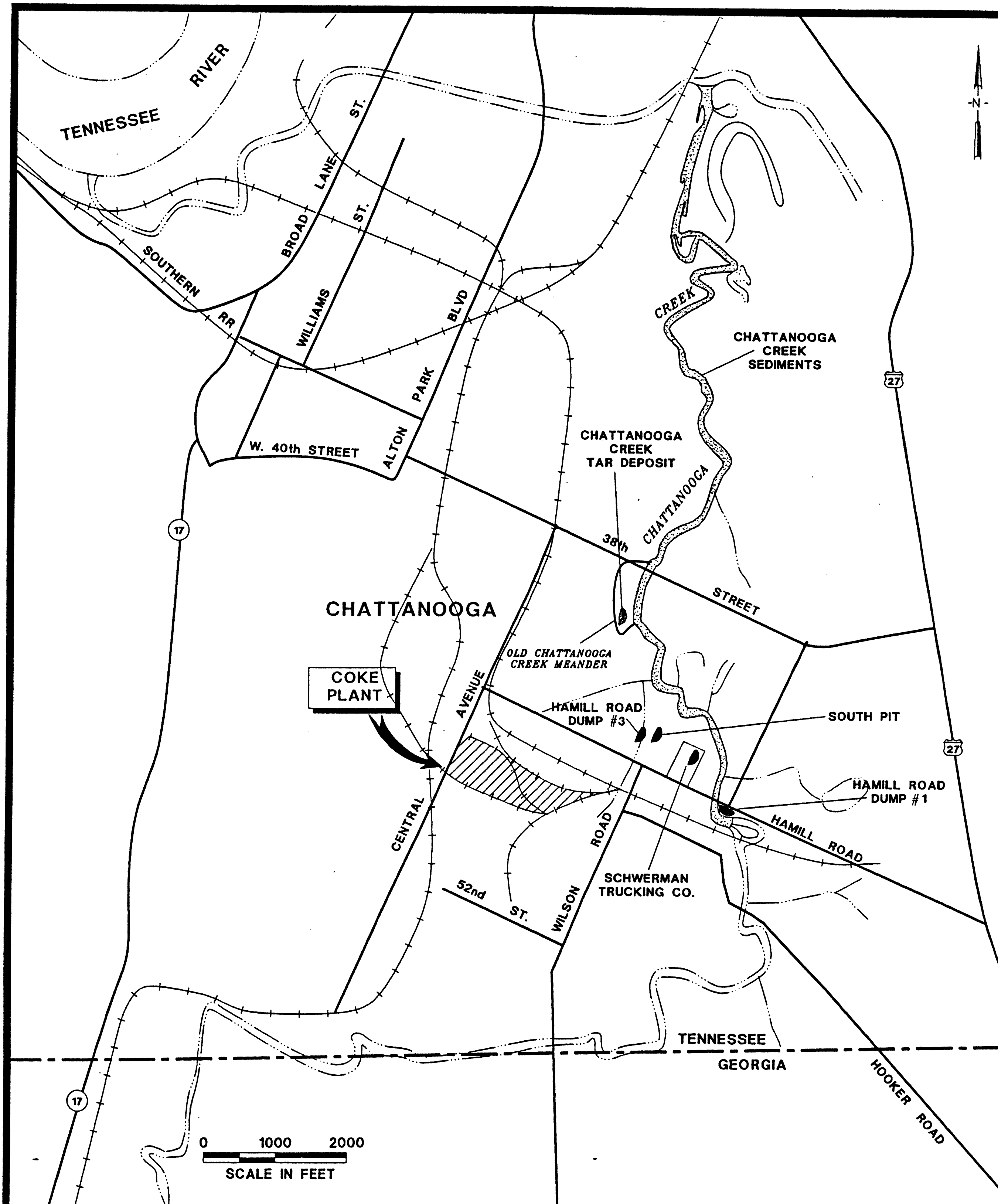
The TP Site is located in an urban industrial and residential area of south Chattanooga in Hamilton County, Tennessee. The site consists of three distinct source areas of contamination: a former coke production plant, its associated uncontrolled waste disposal areas which currently include Schwerman Trucking Site and the Chattanooga Creek Tar Deposit, and approximately 2.5 miles of Chattanooga Creek sediments. The locations of these source areas with approximate site boundaries are shown in **Figure 1-1**. Also shown in Figure 1-1 are the locations of Hamill Road Dumps #1 and #3 and the “south pit”. Coal tar wastes were also found at these three dump sites, but because remedial activities have already been conducted at these sites (see Section 1.4.4), they are not included as part of the Tennessee Products Site.

1.2.2 SITE LAND USE

The former coal carbonization facility or coke plant currently constitutes the largest portion of the site. This portion of the site was occupied by several active coal carbonization facilities from 1918 until 1987. From 1926 until 1964 it was operated by the Tennessee Products Corporation. The coke plant was thus operated by the Tennessee Products Corporation as an owner or lessee continuously for 38 years of the site's 69-year operating history. A historical diagram of the facility (circa 1967) is provided in **Figure 1-2**.

On the northeast corner of the Schwerman Trucking property, located at 1111 Hamill Road, there is a waste deposit. Hereafter, the site will be referred to as the Schwerman Trucking (ST) Site. The property is used by the company to clean and store tanker trucks. A review of historical aerial photographs (USEPA, 1997a and USEPA 1997b) reveals that the Schwerman Trucking facility was constructed between 1968 and 1970, and the waste was deposited on the property between 1976 and 1978.

The remaining portions of the Tennessee Products site are the result of uncontrolled dumping of coal tar in the floodplain and stream bed of Chattanooga Creek. The coal tar dumps are the result of many years of uncontrolled dumping of coal tar directly into the creek, along the creek bank, or in the creek floodplain. A review of the historical aerial photographs (USEPA 1997a) indicates that the floodplain of the creek has been generally undeveloped since at least 1942 (the date of the earliest photograph). This would be expected given the frequent flooding



REGIONAL SITE MAP

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Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-1

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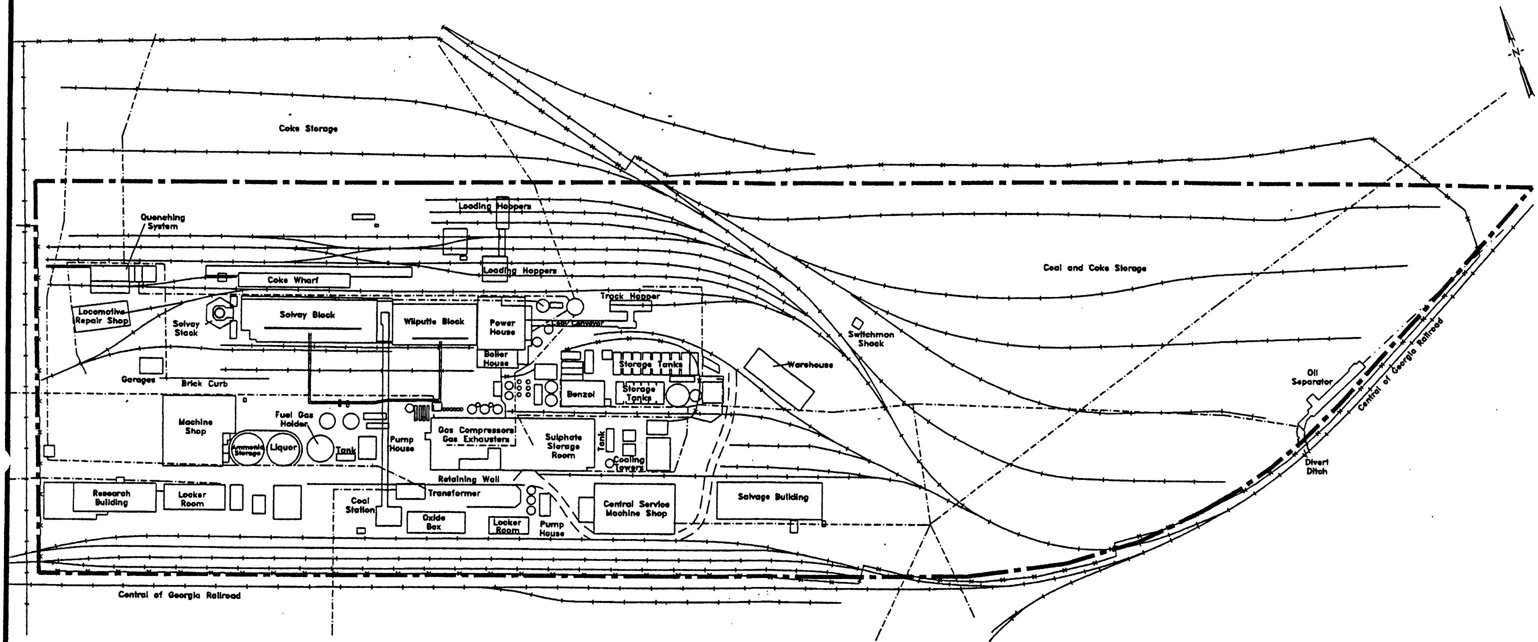

LEGEND

- Coke Plant Boundary
- Railroad
- Fence
- Underground Lines

Not To Scale

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COKE PLANT HISTORICAL (Circa 1967) SITE MAP

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-2

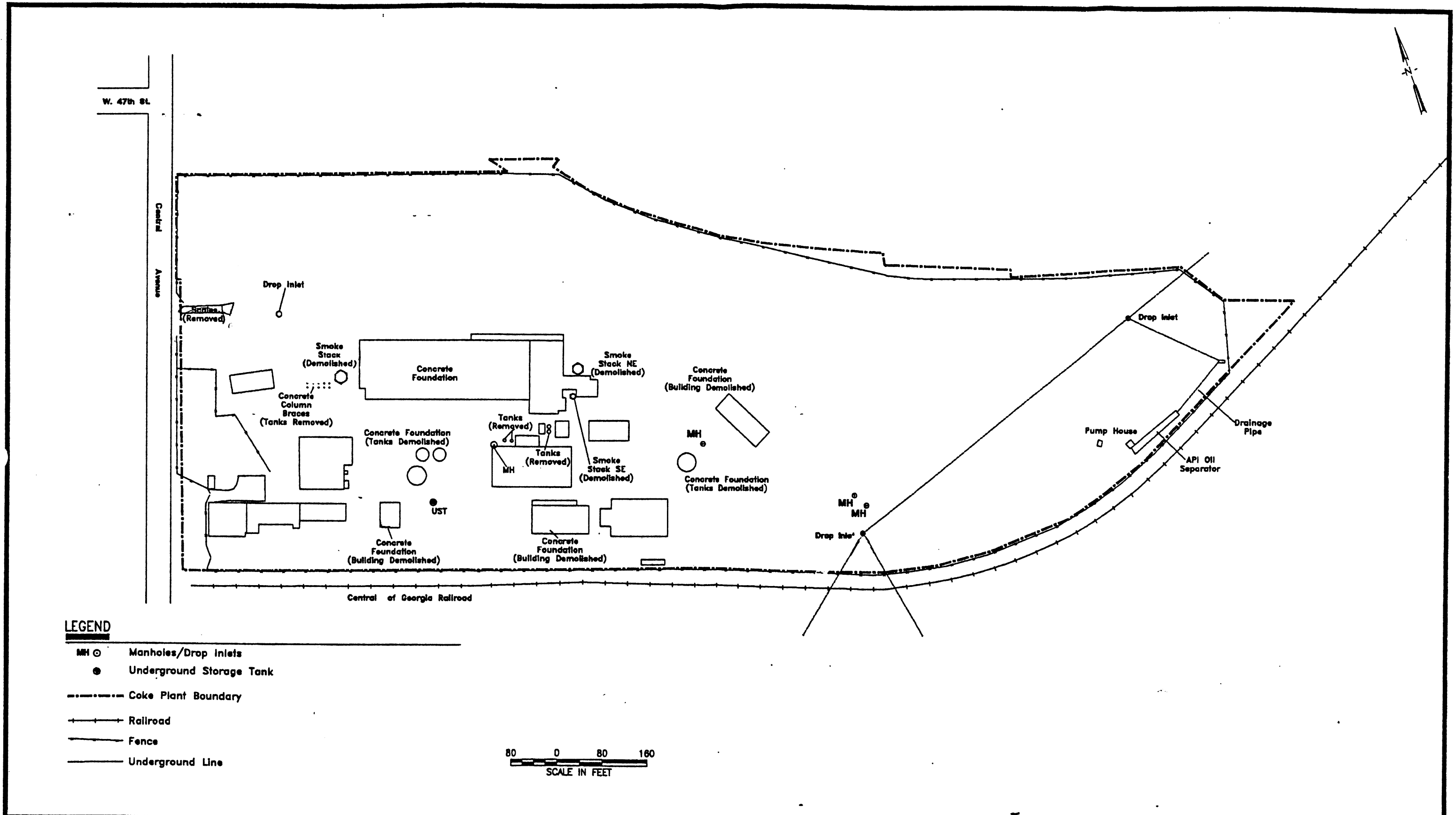
associated with the creek. The first indication of Hamill Road Dump #1 appears in a 1942 photograph. In the area of the South Pit, "dark liquid" is noted on the interpretation of the 1953 aerial photograph. A "ground scar" is identified in the area of Hamill Road Dump #3 on that same photograph.

1.2.3 SITE PHYSICAL FEATURES

The coke plant facility is situated in a low lying area bordering the Chattanooga Creek floodplain. Relief across the essentially flat site is less than 26 feet and the general slope is to the east. The facility occupies 24 acres. A recent diagram of the coke plant facility is provided in **Figure 1-3**.

All the railroad tracks on the plant property appear to have been removed. In addition, all previous above ground structures (except for the building foundations) at the site have been removed. However, there is still one known underground storage tank (UST) of unknown size, and many manholes, underground conduits, and pipelines, the configuration and depths of which are presently unknown. In addition, the API separator used to separate oil from water, located at the east end of the site, still exists. The UST is closed with a standpipe and a concrete structure. This tank is about half full with 2 feet of water and 2 feet of gasoline. One manhole was observed to be full of water, soil, coke, and debris.

Most of the large piles of coal and coke have also been removed, but there are still two piles located in the eastern portion of the site and one pile located in the northwestern corner of the site which are overgrown with vegetation (see **Figure 1-4**). In addition, a surface layer of coke breeze (generally with a thickness from 2 to 5 feet) extends across the majority of the site. This layer of coke breeze also extends offsite to the north. The only areas onsite noticeably absent of this coke breeze surface layer are where gravel has been spread to facilitate vehicular traffic (covering the coke breeze) and where building foundations are located. The facility is completely surrounded by a newly constructed security fence with warning signs posted. The



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COKE PLANT CURRENT SITE MAP
Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-3

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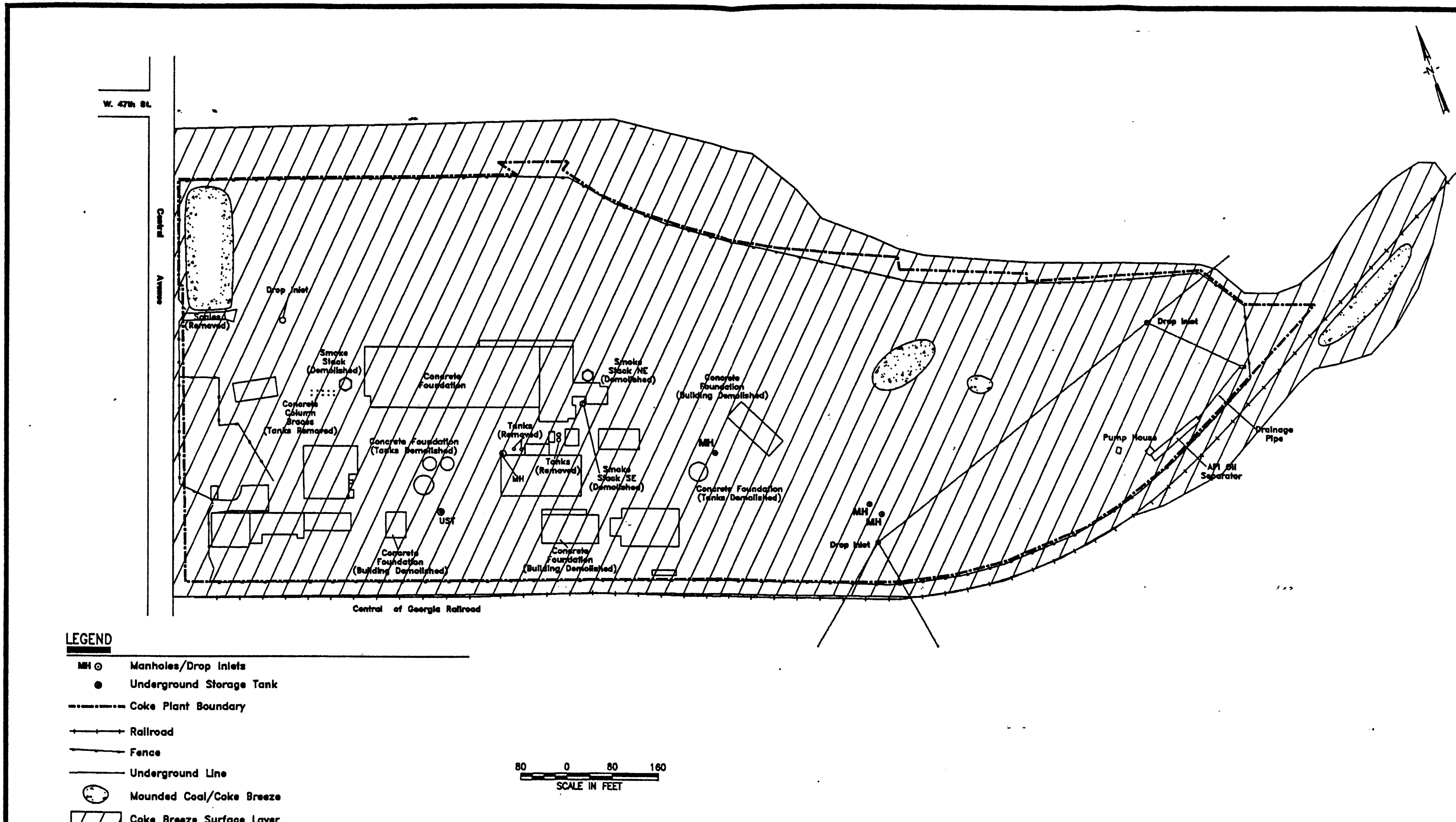

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APPROXIMATE AERIAL EXTENT OF COKE BREEZE

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-4

7/11JUN96/2

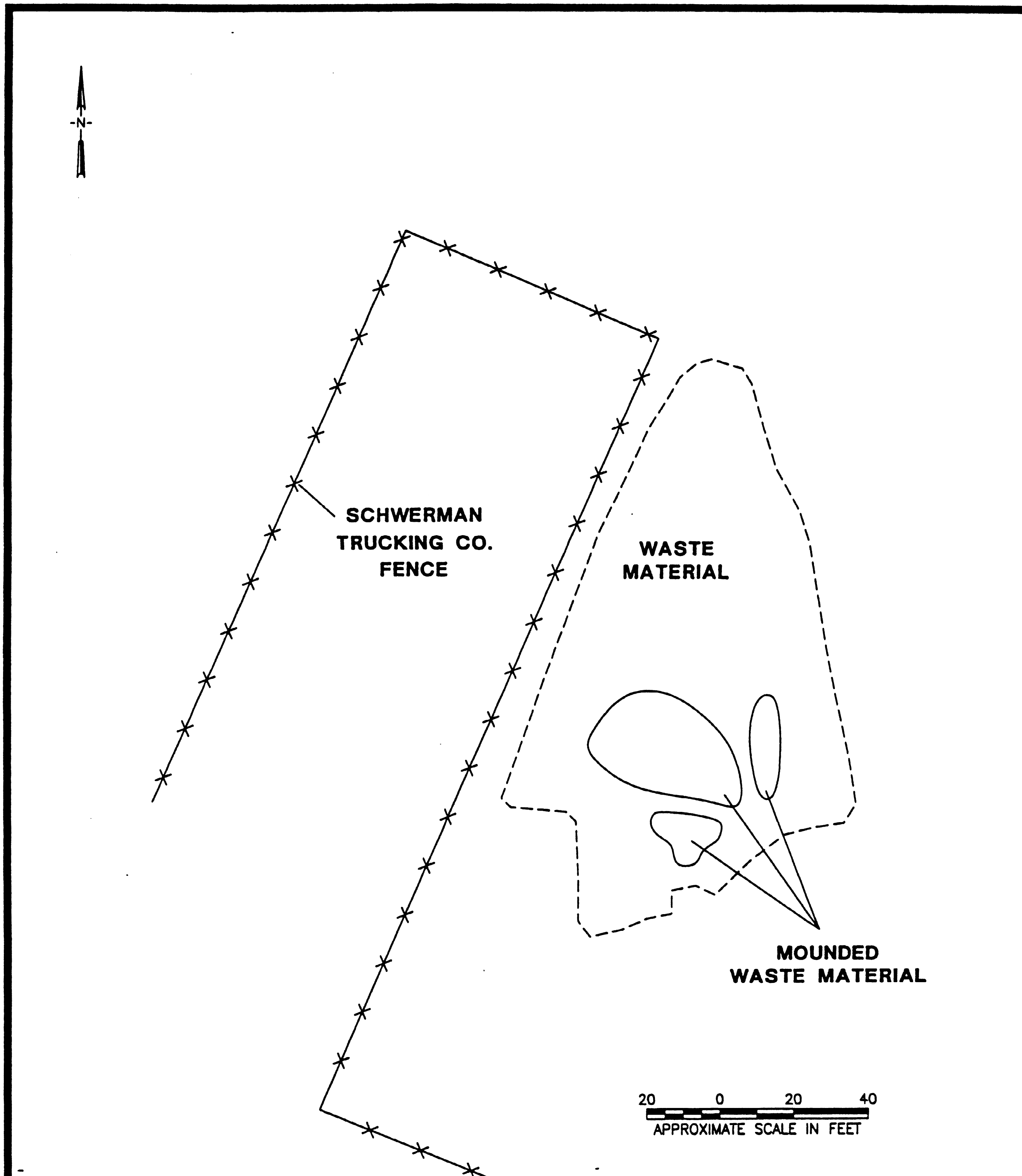
eastern half of the facility is overgrown mostly with low level vegetation. There are also scattered piles of yard debris, such as timbers, located on the facility.

Just northeast of the coke plant, off the coke plant property, was one large coke and coal tar waste pile believed to be associated with the coke plant (see Figure 1-4). This pile was located adjacent to the railroad tracks, on the northeastern side. Several other coke and coal tar waste piles were also located in this area, but they were significantly smaller than the larger pile. The large waste pile was approximately 250 feet long, 35 feet wide, and 10 feet high. As part of the Non-Time-Critical removal conducted in 1997 and 1998 these coke and coal tar waste piles were removed.

Runoff from the coke plant facility takes one of three courses: the sewer system, the Northwest Tributary, or the Northeast Tributary (see Figure 1-1). All three of these courses lead to Chattanooga Creek. Most of the facility runoff is directed toward the API separator, which emptied into the sewer system. According to a US Army Corps of Engineers Report (1995) the sewer discharged into the Chattanooga Creek, just upstream of the Hamill Street Bridge. That report also states that the sewer was documented to exist from at least 1944 and was abandoned at some unknown time. Geophysical surveys conducted during this RI found that the sewer line terminated in surface drainage connected to the Northeast Tributary in the middle of the Landes Company Site. When the APR separator overflows, runoff is directed toward the Northeast Tributary via a ditch located along the eastern property boundary (on the northern side of the railroad tracks). Some of the runoff from the northwestern part of the facility is directed to the Northwest Tributary via underground culverts. A spring located in the northwestern part of the facility (along the northern boundary) also discharges into the Northwest Tributary.

The Schwerman Trucking Site (ST Site) is a small area (less than ¼ acre) located in the

floodplain of Chattanooga Creek on the Schwerman Trucking Company property. A local site map for this area is shown in **Figure 1-5**. The primary physical features of ST Site are the three



dump2/8JUL96/160

SCHWERMAN TRUCKING SITE MAP

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Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-5

mounds of waste material (a dried black sludge) which have a total area of approximately 2,400 square feet and height of approximately 2 feet. The depth of the waste material is unknown. Although a security fence has been installed along the western and southern sides of the dump to separate it from the Schwerman Trucking Company operations, no guard or security fencing presently exists on the northern or eastern sides of the dump.

The Chattanooga Creek Tar Deposit (CCTD) was also located in the floodplain of the Chattanooga Creek. This deposit formerly located in a wooded area west of the present creek channel between Hamill Road and 38th Street in or near an old creek meander, was removed during a Non-Time Critical Removal Action in 1997 (See Section 1.4.4). Trees and light brush vegetation had been growing through the middle of the tar deposit. At the time of the RI, the depth of the deposit was unknown at the time of the RI and the area of the deposit was an approximate 50 foot equilateral triangle (1,250 square feet). The deposit was level and covered by a thin layer of soil and dried mud, which, when undisturbed, disguised the tar and gave the area a deceptively "normal" appearance. An access road to the bank of Chattanooga Creek is located approximately 100 feet south of the deposit. At the time of the RI the tar deposit was surrounded by a security fence to minimize or prevent access.

In Georgia, where Chattanooga Creek originates, the creek flows mainly through undeveloped areas. However, in Tennessee, Chattanooga Creek flows through several industrial areas and urban developments. The creek bed is barricaded by numerous fallen trees and water-level sewage pipes. These natural and artificial barriers impede creek flow and thus collect household litter in their upstream pools that is very heavy throughout the length of the stream.

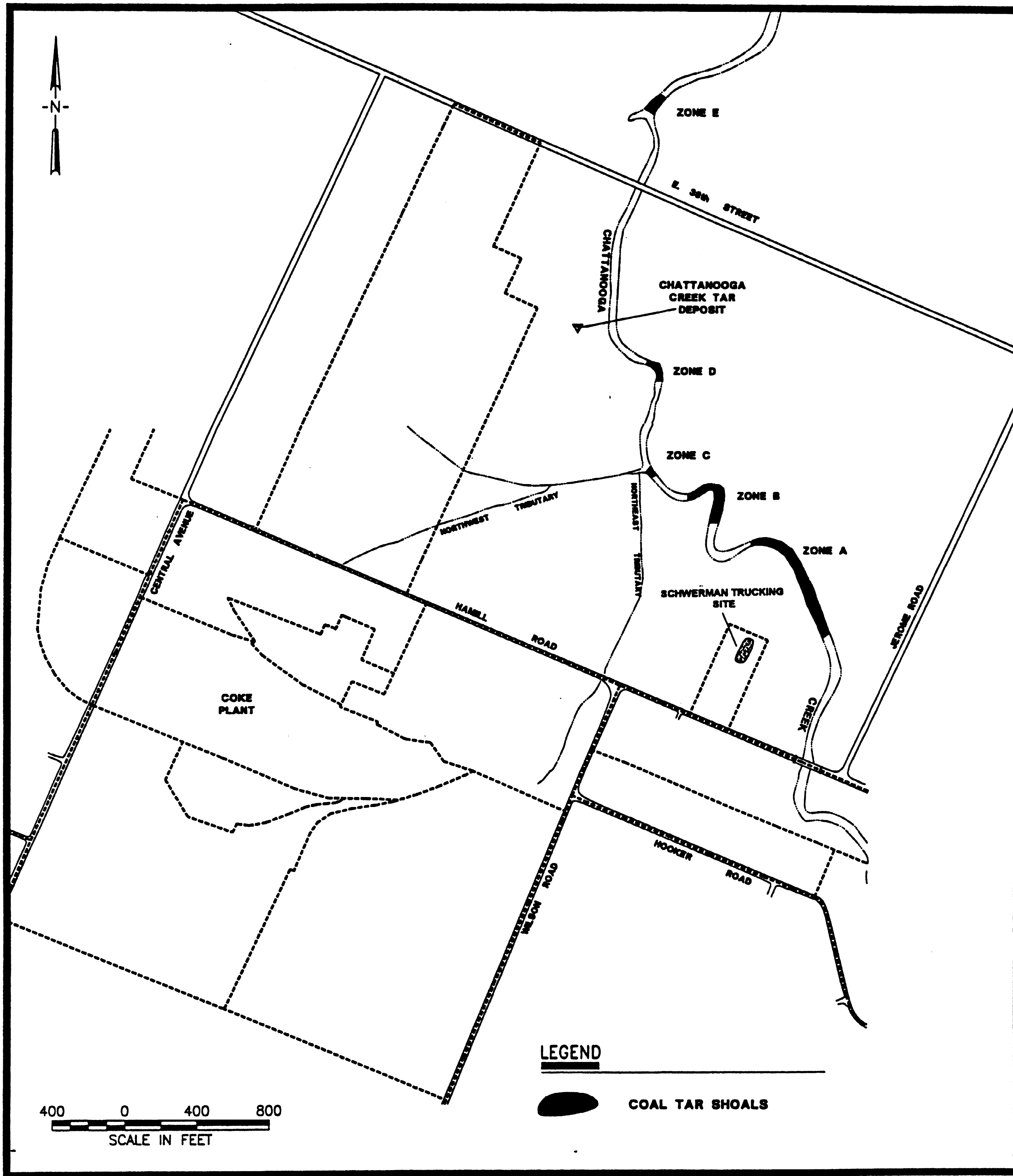
Oily sheens on top of the water have been noted in these areas. In addition, iron bacteria growths resembling oily sheens have been observed along the creek. This bacteria grows abundantly in low-oxygen, non-iron bearing waters. Heavy debris including unidentified metal structures, industrial containers, tires, drums, cars, and animal carcasses have also been observed in the creek bed and along both banks of the stream.

Two distinct types of coal tar accumulations have been identified in Chattanooga Creek. One type of deposit exists as extensive reaches of sediments that are heavily contaminated (saturated) with coal tar. These deposits are present for at least 11,900 feet of the stream bed from a point designated 1700 feet upstream (south) of the intersection of the creek and 38th Street Bridge to the point of the creek's confluence with the Dobbs Branch section of the creek. The second type of coal tar deposit exists primarily as large quantity mounds of coal tar waste in the creek bed. These deposits are located in an area marked by the intersection of the creek and Hamill Road Bridge to a point of overlap with the above deposits approximately 1800 feet downstream (north) of this intersection. Several large distinct shoals of coal tar waste containing high levels of PAHs are located in this reach of the creek bed. The approximate locations of these shoals are indicated in **Figure 1-6**. They are covered by a thin layer of sediment and thus are not readily discernable. The shoals have been divided into five zones.

1.2.4 SURROUNDING LAND USE

The TP Site is located in the South Side Area Planning district as designated by the Chattanooga-Hamilton County Regional Planning Agency. The boundaries of the South Side Planning district are defined to the north by I-24, to the south by the state line, to the east by Chattanooga Creek and to the West by Lookout Mountain. According to 1994 data compiled by the planning agency, the land use for this area is as follows:

- 20 % residential
- 10 % industrial



COAL TAR WASTE DEPOSIT LOCATIONS IN CHATTANOOGA CREEK

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Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-6

coaltar/14JUN96/800

- 27 % vacant (most of which is either on steep slopes or in the flood plain)
- 6 % commercial
- 5 % Institutional
- 9 % Recreation
- 23 % Other (including Streets, Water and Utilities)

Interspersed within the industrial facilities are several public housing projects and many individual residences. The current close proximity of industry and residences to one another is probably due to local historical and evolutionary industrial-commercial requirements for inexpensive, level properties close to existing roads and railways; proximal residential developments for blue collar populations followed, or occurred in concert with, industrial developments. The urban Chattanooga Creek Valley has a long history of industrial development. Much of that development was located near, or in the floodplain of the creek. Therefore, much of the former wetlands in the lower valley have been filled and used by industry. The creek has historically been subjected to gross pollution by industrial waste discharges from coke production, organic chemicals manufacturing, metallurgical and foundry works, tannery operations, and wood treating facilities. Additionally, some members of the public continue to use the creek and floodplain as a solid waste dumping ground. Within the boundaries of the site, a portion of the floodplain remains wooded and undeveloped.

Numerous schools and recreation centers exist in the area. An elementary school is located approximately 0.2 miles east of the coke plant, Alton Park Middle School is located approximately 0.75 miles northeast of the coke plant and adjacent to the creek, Chattanooga Christian School is located approximately 1.5 miles northwest of the coke plant, Calvin Donelson Elementary School is located approximately 1 mile north of the coke plant, and Howard High School is located approximately 2 miles north of the coke plant. The Alton Park Recreation Center is located approximately 0.2 miles north of the coke plant and has children's playground facilities.

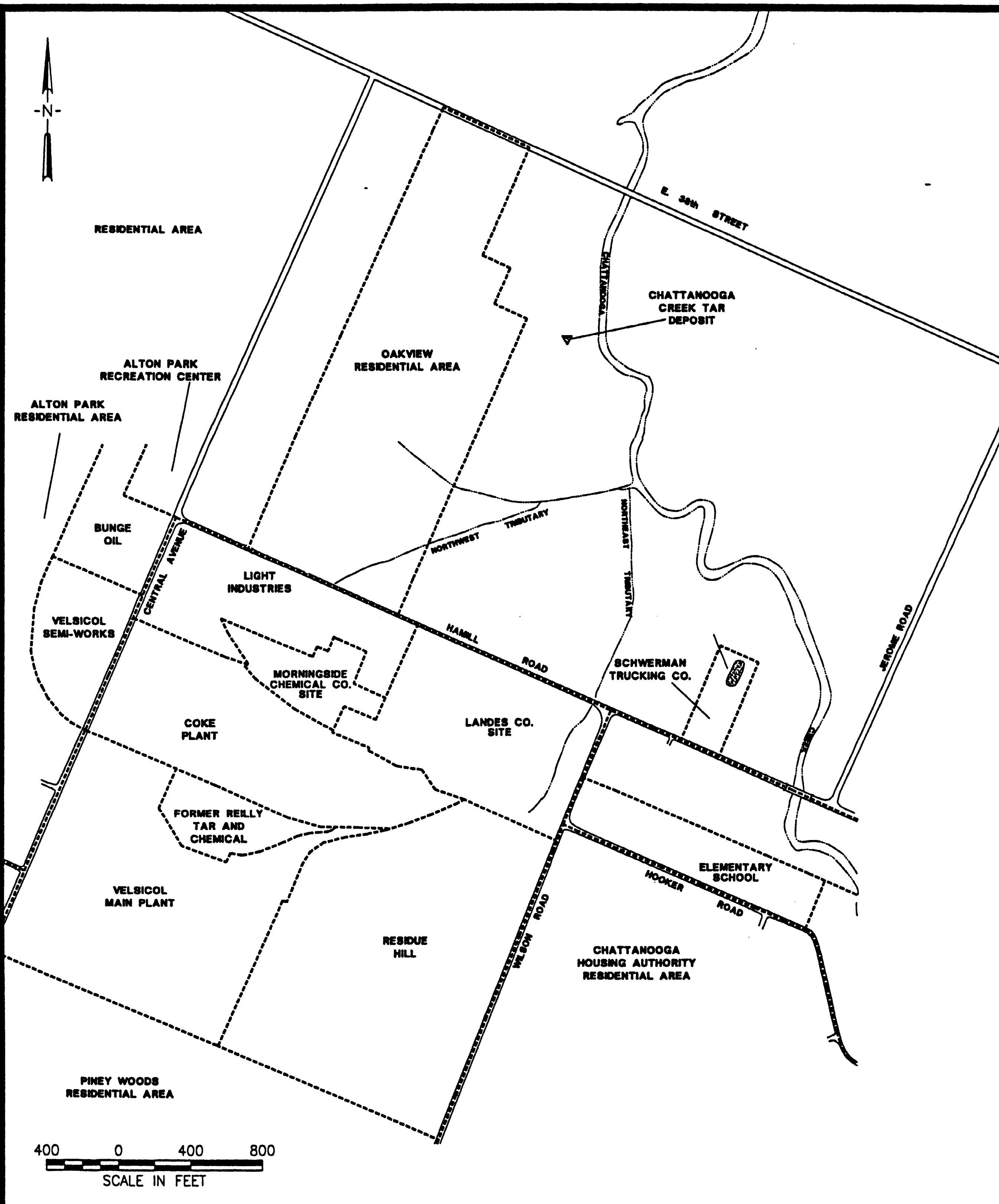
A land use map for the immediate vicinity of the site is provided in **Figure 1-7**. As indicated on this map, while ST Site and the Chattanooga Creek Car Deposit are surrounded primarily by residential, commercial, and undeveloped areas, the coke plant is surrounded by many other industrial facilities. To the south and east is the Velsicol Chemical Corporation's main plant and Residue Hill. To the west is Velsicol's semi-works plant. To the northwest is the Bunge Oil Company. To the north are several small, light industrial facilities which include the Landes Company site and the Morningside Chemical Corporation site. Because the Velsicol Chemical Corporation's main plant, the Landes Company site, and the Morningside Chemical Corporation site are all adjacent to the coke plant and are known to have or previously had hazardous waste contamination problems, the known operational histories of these facilities are briefly discussed below while the results of contamination assessments for these facilities are briefly discussed in Section 1.4.3 (Other Related Site Investigations).

Velsicol Main Plant

The original facility at the Velsicol main plant site was constructed in 1948 by the Tennessee Products Corporation to expand toluene chlorination operations from the adjacent coke plant. The product was sold as an anti-knock additive for gasoline. The Tennessee Products Corporation also operated a Ferro-Alloy facility at this location where metal alloys of iron with silicon, manganese, and chromium were produced for magnets.

In the 1950s, various systems were constructed to produce benzonitrile and benzoguanamine. The facility also synthesized the gamma isomer of hexachlorocyclohexane (gamma BHC or lindane). The production of lindane ceased in 1957. Benzoate esters were also produced from benzoyl chloride in the 1950s. An acid plant was constructed in 1955 to begin recovering muriatic acid, a by-product of the chlorination and benzoyl chloride operations.

Velsicol purchased the facility from the Tennessee Products Corporation in 1963. At the time of the purchase, the following compounds were being produced at the plant: benzoyl chloride,



AREALAND/14JUN96/800

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AREA LAND USE MAP

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-7

benzoic acid, benzyl chloride, benzyl alcohol, benzotrichloride, benzoate esters, benzoguanamine, benzonitrile, benzaldehyde, and sodium benzoate. In 1964, shortly after Velsicol purchased the facility, the ferro-alloy operations ceased and the complex was demolished in 1965.

In 1960, the first air oxidation (A/O) train was installed for the production of benzoic acid by reaction of toluene and air. Other additions in the 1960s included the esterification process, the benzoic acid refining process, and the herbicide Banvel®((dicamba) 3,6-Dichloro-2-methoxybenzoic acid) process. Disposal operations of process residues began on an adjacent property to the east of the present site, now called Residue Hill (see Figure 1-7). In the 1970s, plant expansion continued with the addition of a second A/O train, a benzoic acid purification process, and a direct esterification and continuous chlorination facility. The production of benzaldehyde and sodium benzoate were discontinued in 1973. In 1975, the production of Banvel®(dicamba) ceased and the Banvel® plant was demolished in 1976. The production of CBE (meta methyl chlorobenzoate) for the Mobil Corporation began in 1976 and ended in 1979.

In 1976 Velsicol purchased a parcel of land, presently located in the northeast section of the plant, from Reilly Tar and Chemical. The Reilly Tar property had been used to produce coal tar products (road tar and roofing pitch and other coal tar pitches) from 1921 to 1972. The tar products were made from the by-products of the adjacent coke production plant.

In the 1980s, the product line at the Velsicol facility was reduced to benzoyl chloride, benzoic acid, muriatic acid, and benzoate esters, but an effort was made to increase the capacities of benzoic acid and varieties of benzoate esters. In 1986, Northwest Industries (Velsicol's parent company) sold the facility to the current owners but retained ownership of Residue Hill. The Velsicol facility currently occupies about 50 acres.

Residue Hill occupies approximately 50 acres and was originally used as a disposal site for the Ferro-Alloy facility. The waste contained heavy metals. From 1963 to 1974 herbicide residues were disposed of on the hill by the Velsicol Chemical Plant. The residues were pre-treated in settling ponds on the hill and then the liquid phase was discharged to the municipal sewer system. Acid neutralization pits were also present on the hill. Benzoyl chloride residue, benzoic acid still bottoms, benzotrichloride still bottoms, spent carbon from a hydrochloric acid plant and Banvel®(dicamba) contaminated materials were disposed of at the site. The majority of the surface impoundments were covered sometime in 1973 to control air emissions. The "cap" consisted of a grass seeded clay covering. Large numbers of drums were stored on the site at various times in the 1970s. The drums contained "chemical residues" to be burned in an onsite waste burner. About 12,000 drums were stored onsite in mid-1974 and leaking drums were present at that time. They reportedly were removed by a disposal contractor in 1975. All disposal practices were discontinued in 1974. In 1977, the disposal area was discovered to be actively leaching to the drainage ditches around the hill which were overflowing during rain events. The overflow was running into a swamp located southeast of the site. Residue Hill was capped again by Velsicol in late 1980. This cap used an impermeable membrane liner and clay cap to control infiltration and subsequently leachate from the disposal area. During the construction, waste residue and approximately 50 to 100 drums were uncovered east of the site in an area previously believed to be free from contamination. The cap was extended over the newly discovered drums and residues.

Residue Hill rises approximately 50 feet above the surrounding area. Surface water runoff is routed through a series of drainage ditches running along the south and east side of the hill to the city sewer. Groundwater seeps are present all around the hill. The site is completely fenced by a large chain link fence with barbed wire on top.

Landes Company Site

The Landes Company site occupies approximately 17 acres of land. From the early 1960s until 1991, businesses at the Landes Company site engaged in metal fabrication and in the manufacturing and rental of concrete forms and scaffolding. Operations at the site involved welding, machining, and painting. Raw sewage, shop oils, and sludges were discharged into the

Northeast Tributary which emptied into Chattanooga Creek. In addition, manufacturing process wastes were apparently discharged directly on the ground at one time.

The Landes Company site is currently being used by Signet Contracting, the Winton Company, and Simmons Demolition for the storage of pipe insulation products, truck parts, and construction equipment, respectively. There is currently no manufacturing or waste disposal occurring onsite. However, several piles of sandblasting sand and foundry sand and slag, as well as the piles of coke and coal debris believed to be associated with the coke plant (see Section 1.2.3), are present in the southeastern part of the site (on the southern side of the railroad tracks).

In August of 1996, during construction of a warehouse on the eastern portion of the property, contaminated soil was encountered. CDM Federal collected samples of soil, waste, and surface water at that time. EPA subsequently referred the site to the Tennessee Department of Environmental Conservation (TDEC) (formerly TDHE).

<u>Morningside Chemical Company Site</u>

The Morningside property has been used as an industrial facility since 1947. The property was used as a distribution center for heavy industrial chemicals by Vol State Chemical from 1968 to 1976. The warehouse and what is now the dye mixing area were utilized as a storage area largely for dry chemicals and a few liquids. Most liquids marketed by Vol State Chemical were stored in another building located to the west of the existing facility. The loading docks, loading platform, and vault areas were used for receiving and dispatching material from Vol State Chemical and not for storage and mixing. The basement area was not used; however, 104 non-reusable sodium silicate drums were stored there.

In 1976, a fire at Vol State Chemical rendered several tons of industrial chemicals unmarketable (mostly due to damaged packaging). After the fire, approximately 170 55-gallon drums of various chemicals were placed in the basement, and an unknown quantity of hazardous solids, liquids, and sludges were drummed and buried in a trench landfill behind the building. The trench landfill was reported to run parallel to the railroad spur behind the existing building and to increase in depth from near surface at the west end to approximately 15 feet at the east end. Later, approximately 40,000 gallons of contaminated sewage accumulated in the basement due to plumbing leaks.

In 1978, the facility was sold and then operated as Morningside Chemical Company. In 1983, upon ownership changes, the company was renamed Jones Dyestuffs. The operations of Morningside Chemical and Jones Dyestuffs involved the mixture of various pigments or coloring agents from smaller containers into tanks or drums for the carpet industry. Any spillage was wiped up or washed down through floor drains into the basement. The floor drains have been plugged and no longer drain to the basement. Dyestuffs were also stored on the loading docks and loading platforms. By 1991, the operations of Jones Dyestuffs was terminated and the building vacated.

1.2.5 AREA WATER USE

Private drinking water wells are not known to exist within a 4-mile radius of the site. Drinking water for the area is supplied by the Tennessee-American Water Company whose intake on the Tennessee River is located approximately four miles upstream of the confluence of Chattanooga Creek and the Tennessee River. Groundwater is also not known to be used for irrigation or livestock watering in this urban area. The closest active industrial wells to the site are Southern Cellulose Products' two wells (both 150 feet deep) on 38th Street, and the Chattanooga Glass Company well (325 feet deep) on West 45th Street.

There are no known nearby surface water withdrawals (for drinking water) located downstream of the site in Chattanooga Creek or the Tennessee River. The closest downstream public water withdrawal intake is located in South Pittsburg, Tennessee, on the Tennessee River. South Pittsburg is located approximately 30 river miles downstream from the confluence of

Chattanooga Creek and the Tennessee River. However, although posted with warning signs, Chattanooga Creek is used for swimming, playing, and fishing by both children and adults. Consumption of fish caught from the creek has been reported. In addition, homeless people are reported to be bathing in the creek and drinking the creek water.

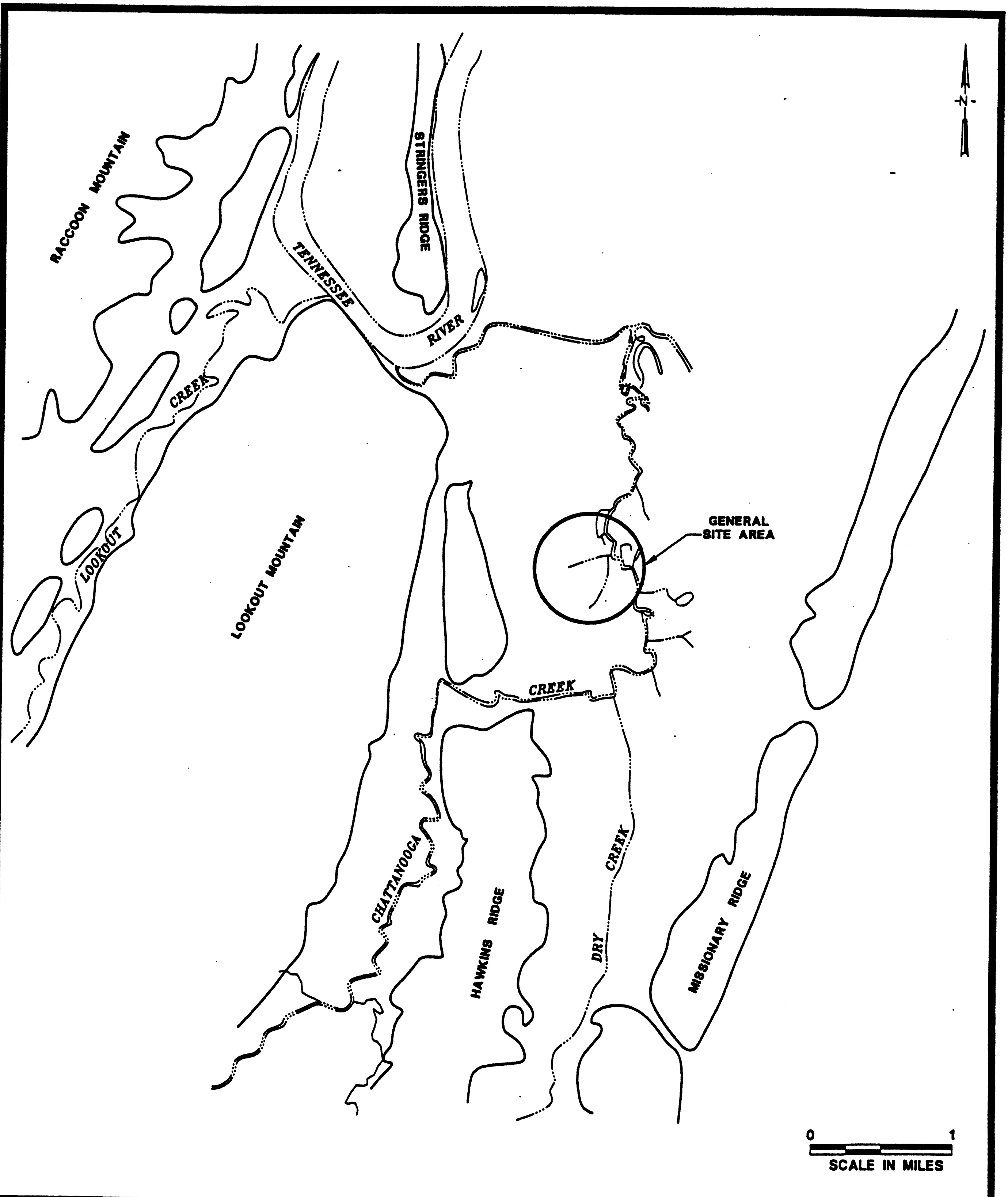
1.2.6 DEMOGRAPHY

According to 1990 census data, 5331 people reside in Census Tract 19. This population is 98% African-American and 1% white. A relatively high population of youth live in the area, since 36% of the population is under the age of 18. 87% of the residents are under the age of 65. The median value for homes is $30,100, indicating a relatively low socio-economic status for the area.

1.3 ENVIRONMENTAL SETTING

1.3.1 PHYSIOGRAPHY/TOPOGRAPHY

The TP Site is located in the Chattanooga Valley within the Valley and Ridge Physiographic Province between Lookout Mountain to the west (Appalachian Plateau) and Missionary Ridge to the east (Valley and Ridge). **Figure 1-8** presents a physiographic map of the region. The Valley and Ridge Province extends as a narrow belt of folded strata from central Alabama to northeastern Pennsylvania. It consists of alternating valleys and ridges which are generally parallel and trend northeast-southwest. It is characterized by topography resulting from differential erosion of folded strata. Near Chattanooga, the southern section of this province is dominated by slightly larger valley floors, less relief and southeast dipping strata. The



REGIONAL PHYSIOGRAPHIC MAP

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Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-8

PHYS/5may95/1=1

elevations of the tops of ridges are generally about 1000 feet above mean sea level (msl). Near the site, the highest elevation is Lookout Mountain, with an elevation of 2140 feet above msl. The lowest elevation is at the Tennessee River flood plain with an elevation of about 634 feet above msl. At the site, along the valley floor, surface elevations range from approximately 690 to 640 feet above msl. A topographic map of the coke production plant area is provided in **Figure 1-9**.

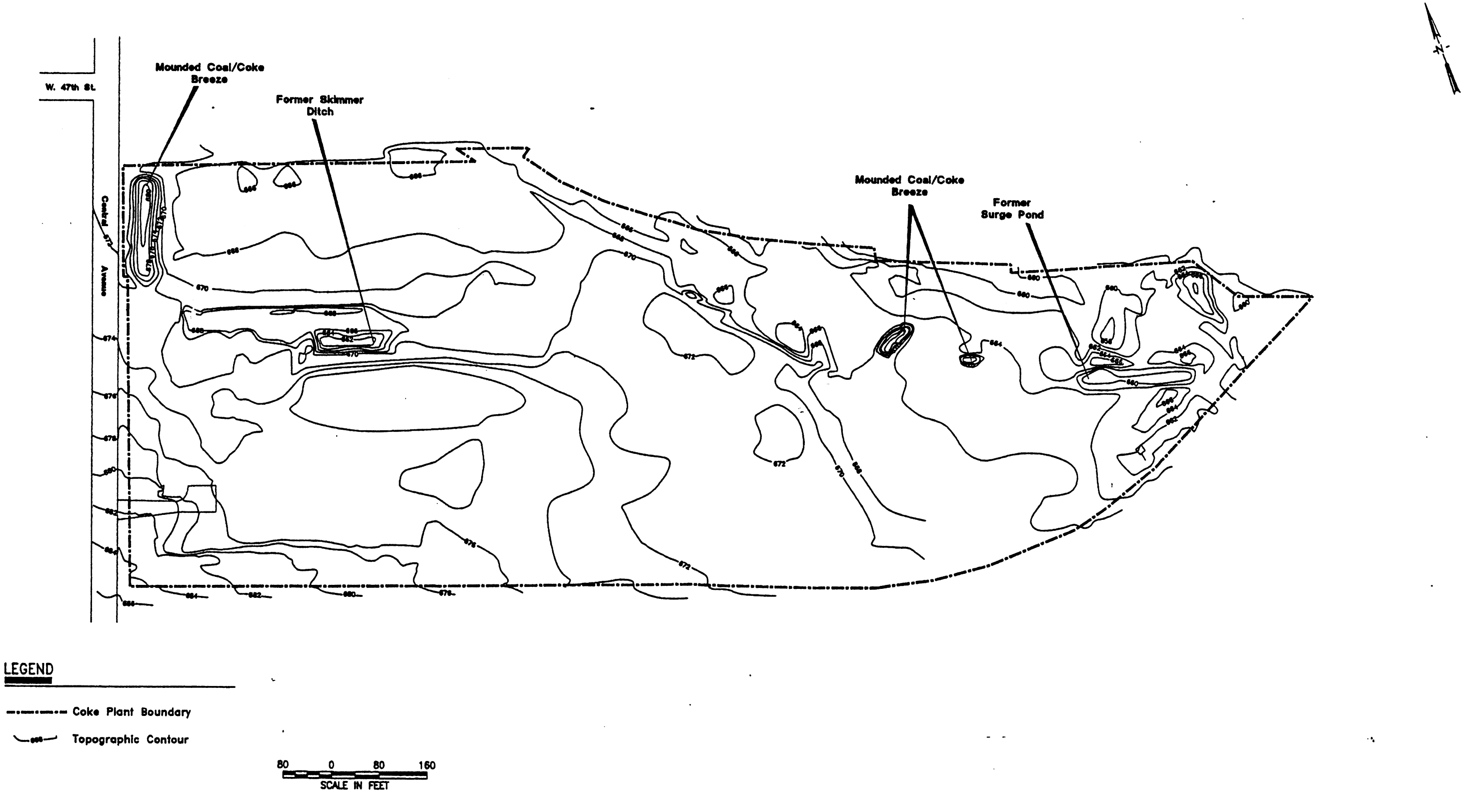
1.3.2 CLIMATE/METEOROLOGY

The climate of the area is generally mild. Cold air currents moving south from Canada and warm air currents moving north from the Gulf of Mexico affect the daily changes and seasonal variations in the weather.

Based on a 40 year period of record, the average annual temperature is 59.7 degrees Fahrenheit (^{o}F), the average annual precipitation is 52.6 inches, and the average annual number of frost-free days is 215. The temperature is generally in the 30 to 50^{o}F range in the winter, and the 70 to 90^{o}F range in the summer. July is the hottest month, with an average temperature of 78.7^{o}F, and January is the coldest month, with an average temperature of 38.7^{o}F. The wettest month is March, with an average rainfall of 6.31 inches, and the driest month is October, with an average rainfall of 2.92 inches.

1.3.3 SOILS

The site lies entirely within the floodplain of Chattanooga Creek. Therefore, soils are comprised entirely of alluvial deposits in both the creek bed and along the terraces. Soils in the upstream portion of the site consist primarily of Tupelo silty loam. The Tupelo, according to the Soil Conservation Service (SCS), is characteristically a deep, somewhat poorly drained soil which rarely has slopes greater than three percent. Typically, the surface layer is a yellowish-brown silty loam approximately eight inches thick. The subsoil generally extends to



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COKE PLANT
TOPOGRAPHIC MAP
Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-9

a depth of approximately 48 inches. The upper part of the subsoil is also a yellowish-brown silty loam with mottled brownish-gray clay. Beneath that is gray clay to a depth of five feet. The soil is low in natural fertility and organic content. It ranges from slightly to strongly acidic. Permeability is low and the available water content is moderate. The clayey subsoil restricts the movement of air and water and the growth of extensive root systems.

Downstream of the Tupelo soils, north of the 38th Street Bridge, the soils grade into the Newark Series. They also are poorly drained, nearly level soils commonly found in flood plains and depressions. Slopes range up to 3 percent, but commonly are less than 2 percent. The Newark's surface layer is typically a dark grayish-brown silt loam about six inches thick. The subsoil is generally about 2 1/2 feet thick and in its upper part is a mottled brown to grayish-brown silty loam. The lower part of the subsoil is a gray silty loam. Newark soils are moderately fertile and contain a fair amount of organic matter. They are slightly acidic to mildly alkaline. The available water capacity in the pore spaces is high, permeability is moderate and runoff is slow.

Near the Chattanooga Creek's confluence with Dobbs Branch, the SCS classifies the soils into the Colbert-Urban Land Complex Series. This unit consists of deep, moderately well-drained, gently sloping Colbert soils, urban land, and disturbed areas as a result of construction activities. This unit can occasionally be found further upstream within the Tupelo and Newark soil units. Near Dobbs Branch, Colbert soils make up 25 to 45 percent of the land surface, urban development approximately 25 to 45 percent and disturbed areas about 10 to 25 percent. Typically, Colbert soils have a surface layer of brown silt loam four inches thick. The subsoil is a yellowish-brown clay that is mottled in its lower part. It is generally about four feet thick. Limestone bedrock can often be found at depths of less than ten feet in this area. Colbert soils are low in natural fertility and organic content. They are slightly to strongly acidic, except in the layers just above bedrock. These soils are mildly alkaline. Permeability is very low and the available water capacity is moderate. The shrink-swell potential is high and the soils are poorly suited for most construction purposes. The disturbed areas have been excavated during installation of utilities and cut and filled during grading operations. They are altered to the extent that individual soils cannot be identified nor judgements made about their suitability for specific uses.

1.3.4 REGIONAL GEOLOGY

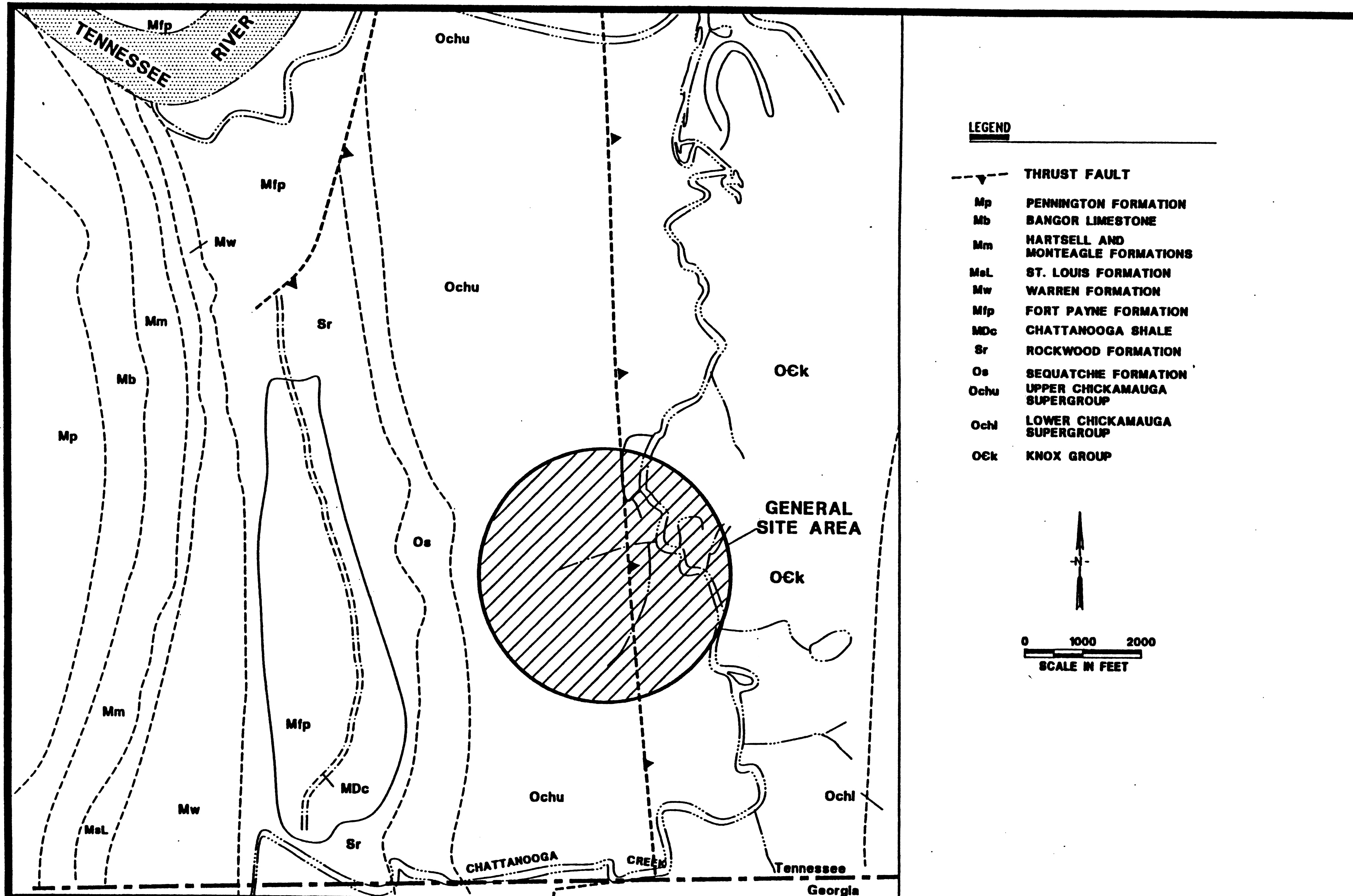
The Valley and Ridge Province is characterized by numerous northeast-southwest trending elongated valleys and ridges composed of Paleozoic carbonate and clastic rocks. These rocks are predominantly limestone, dolomite, shale, and sandstone. Generally, the ridges are formed of resistant layers of sandstone while the valleys are underlain by more erodible limestone, dolomite, and shale. Streams in the Valley and Ridge Province typically form trellis drainage patterns reflecting structural control by the rock. The rocks of the Valley and Ridge Province have been subjected to thrust faulting and are typically folded into elongated anticlines and synclines, resulting in moderate to steep angles of dip.

The stratigraphy of the region is summarized in **Table 1-1**. The variation in bedrock across the region is displayed in **Figure 1-10** where a geologic map of the region is provided and in **Figure 1-11** where a northwest-southeast trending geologic cross-section of the region is provided. As indicated in these figures, the region is underlain by rocks of Ordovician to Mississippian age. Chattanooga Valley, where the site is located, is underlain by several units forming the Lower Ordovician Knox Group and the Middle Ordovician Chickamauga Supergroup. The Knox Group forms the central portion of the valley and consists of several formations of dolomite and limestone. The Chickamauga Supergroup forms the east and west sides of the valley. The lithology of the Chickamauga Supergroup is complex, with changes both laterally along structural trends and across thrust faults. The Chickamauga Supergroup consists of two groups: the Stones River Group (primarily limestone formations) and the Nashville Group (several shaley limestone formations).

TABLE 1-1

REGIONAL STRATIGRAPHIC UNITS
TENNESSEE PRODUCTS SITE
CHATTANOOGA, TENNESSEE

SYSTEM	SUPERGROUP/GROUP		FORMATION	THICKNESS (FEET)	WATER-BEARING PROPERTIES
Pennsylvanian		Crab Orchard Mountains Group	Several formations	570 to 1125	Sandstones and conglomerates yield small quantities of water. Shales yield little or no water.
		Gizzard Group	Several formations	500 to 840	
Mississippian			Pennington Formation	300 to 500	Limestones yield moderate quantities of water. Shales yield little or no water.
			Bangor Limestone	300 to 400	
			Hartsell Formation	10 to 50	
			Monteagle Formation	300 to 400	
			St. Louis Formation	100	
			Warsaw Formation	0 to 72	
			Fort Payne Formation	250	Yields moderate to large quantities of water.
Devonian			Chattanooga Shale	13 to 50	Impermeable.
Silurian			Rockwood Formation	600	Yields minor quantities of water.
Ordovician			Sequatchie Formation	250	Poor aquifer.
	Chickamauga Supergroup	Nashville Group	Catheys Formation	200	Yields small amounts of water.
			Cannon Limestone	200	
			Hermitage Formation	100 to 120	
		Stones River Group	Carters Limestone	300	Yields moderate amounts of water from solution cavities.
			Several formations	1350	
		Knox Group	Several formations	2675 to 2810	Yields large quantities of water.



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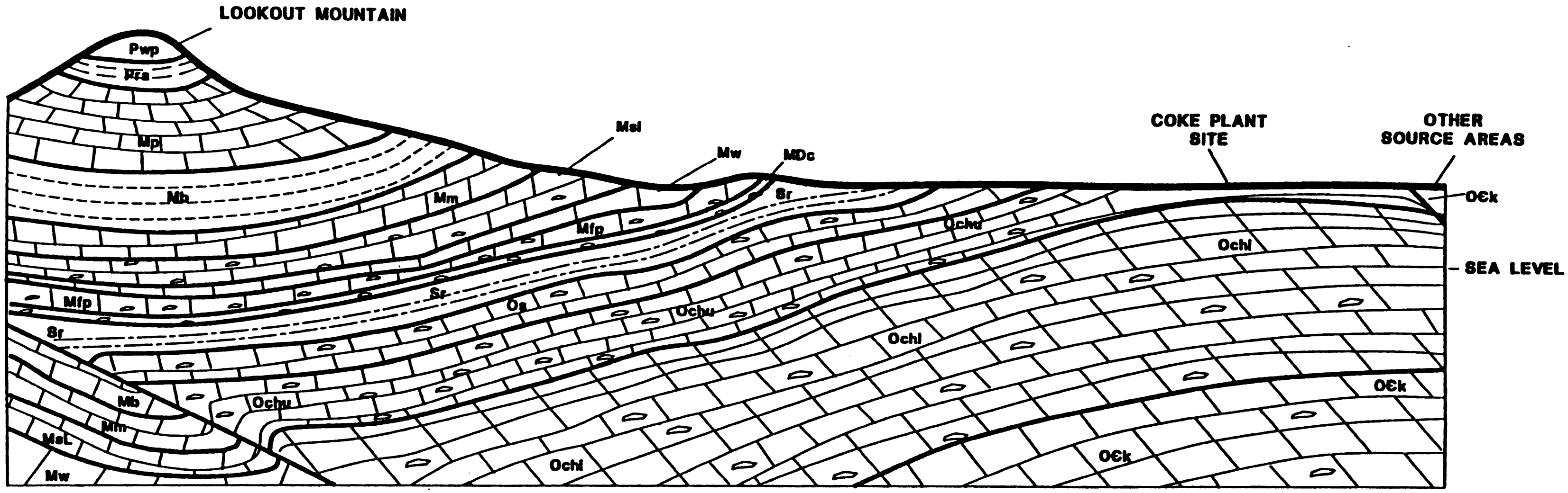
REGIONAL GEOLOGIC MAP

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-10



LEGEND

Pwp	WARREN POINT SANDSTONE
Pra	RACCOON MOUNTAIN FORMATION
Mp	PENNINGTON FORMATION
Mb	BANGOR LIMESTONE
Mm	HARTSELL AND MONTEAGLE FORMATIONS
MsL	ST. LOUIS FORMATION
Mw	WARREN FORMATION
Mfp	FORT PAYNE FORMATION
MDc	CHATTANOOGA SHALE
Sr	ROCKWOOD FORMATION
Os	SEQUATCHIE FORMATION
Ochu	UPPER CHICKAMAUGA SUPERGROUP
Ochl	LOWER CHICKAMAUGA SUPERGROUP
O€k	KNOX GROUP

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REGIONAL GEOLOGIC CROSS SECTION

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-11

The Stones River Group primarily consists of gray to dark gray, sometimes fossiliferous, thin to thick-bedded, limestone with greenish grayish-red silty limestones, mudstones, and shale interbedded. The Stones River Group has been divided into six formations, referred to in Table 1-2 as "several formations" and Carters Limestone. In ascending order, these six formations are: the Pond Spring Formation, Murfreesboro Limestone, Ridley Limestone, Jewell Bluff Formation, Lebanon Limestone, and Carters Limestone. The upper member of this group (Carters Limestone) contains bentonite beds.

The Nashville Group primarily consists of yellowish-gray to dark gray, argillaceous, sometimes fossiliferous, thin to medium-bedded or platy to nodular limestone. Shale layers are also present in the Nashville Group. The Nashville Group is reported to have a thickness of about 510 feet in Hamilton County. The Nashville Group has been divided into three formations which are, in ascending order: the Hermitage Formation, Cannon Limestone, and Catheys Formation. The three formations are difficult to differentiate, except in areas of widespread outcrops. Locally the lowest formation (Hermitage Formation) has a 2-foot calcareous sandstone at the base of its contact with the underlying Carters Limestone.

The Chattanooga fault (see Figure 1-10) is a major eastward-dipping thrust fault that occurs near the center of Chattanooga Valley. Rocks east of the fault (the upper part of the Knox Group, the Stones River Group, and portions of the Nashville Group) dip gently eastward. Rocks west of the fault (upper Nashville Group and overlying formations) generally dip gently westward on the eastern flank of the Lookout Mountain syncline.

Carbonate rocks such as limestone and dolomite tend to weather along planes of least resistance such as fractures, joints, and bedding planes. This type of weathering may cause the soil/bedrock contact to be pinnacled and/or slotted with more resistant beds of limestone protruding into the soils above. The limestones typically weather to plastic, silty clays.

Sinkholes are found in the limestones and dolomites of the region. The majority of sinkholes mapped in Hamilton County are in the Knox Group. There are small and scattered sinkholes also in the Stones River Group.

In 1994, Law Engineering conducted a RCRA Facility Investigation (RFI) at the Velsicol property, which is adjacent to and south of the coke plant. As part the RFI, Law performed a lineament survey of the region using infrared aerial photographs. A total of 241 lineaments were identified within a three-mile radius of the site. These lineaments have a dominant orientation of N70ºE and N80ºW. Lesser concentrations oriented N30ºE to N70ºE and N50ºW to N80ºW were observed. A few lineaments oriented N30ºW and N20ºE were also observed. The lineaments were identified on the ridges and slopes in the region; however, the valleys of Chattanooga Creek and other streams in the region contained no identifiable naturally-occurring linear features. Extensive cultural development of these valleys has destroyed any subtle features that might have existed.

1.3.5 REGIONAL HYDROGEOLOGY

Groundwater in the region occurs within both the unconsolidated and consolidated materials. The unconsolidated materials include the alluvial deposits and residuum described above. These materials generally have low water yield and are thus not considered an important groundwater source.

The consolidated materials consist of shale, sandstone, limestone, and dolomite that form the bedrock. Water in limestone typically occurs in secondary features such as fractures and bedding planes, particularly those that have been enlarged by solution of calcareous material. These features occur erratically and cause hydraulic conductivities to be extremely variable throughout the region. This property explains why one well may be dry and another nearby well at the same depth into the bedrock produces water. Typically, most of the water encountered in limestone is near the top of the rock where weathering has increased the number of secondary features.

Shales generally have low yields. Sandstones, particularly those on Lookout Mountain, may yield large quantities of water. Limestones and dolomites produce variable amounts of water depending on the number and size of fractures and solution cavities encountered. The water bearing properties of the rock units in the region are briefly described in Table 1-1. In general, the most productive aquifers in the region are the formations of the Knox Group.

Groundwater is recharged primarily by the percolation of rainwater through the soils. Generally, groundwater discharges locally to ponds, streams (such as Chattanooga Creek), springs, and by general seepage.

1.3.6 REGIONAL HYDROLOGY

Chattanooga Creek is in the Tennessee River basin, which is regulated by a series of dams along the river and large tributary dams in the headwaters. Chattanooga Creek originates from the slopes of Georgia's Lookout Mountain, flows approximately 26 miles northward into Tennessee and eventually into the Tennessee River just downstream of downtown Chattanooga, and above Nickajack Reservoir. Nickajack Lake is the result of the Tennessee Valley Authority (TVA) constructing a hydroelectric dam at river mile 425. The creek is a gaining stream throughout its course and in its Georgia headwaters is fed by several springs. Some of the more notable springs feeding it are Powder Mill, Tannery, Crutchfield and Blowing. Except for Dobbs Branch, three miles upstream from the mouth of the creek, the majority of contributing tributaries also enter the creek's base flow in Georgia. A few of the bigger streams, moving from the headwaters, are Powder Mill Branch, Ellis Branch, Rock Creek and Dry Creek. The creek has a watershed of nearly 75 square miles, of which approximately twenty percent is in Tennessee. It occupies the northern portion of the Chattanooga Valley between Lookout Mountain and Missionary Ridge.

Average streamflow in Chattanooga Creek in Tennessee is on the order of 100 cubic feet per second (cfs). The creek falls about 1.5 feet per mile and is relatively shallow, usually not over 4 feet deep and in many places much less, on the order of 3 to 4 inches, depending on the time of year. The average depth appears to be 2 to 4 feet, except where artificially deepened. In the extremely shallow areas, a brisk current is evident, but along most of the length of creek in Tennessee, the current is scarcely discernable. The stream banks appear to average approximately 2 to 4 feet, except where artificially heightened. Periodic flooding occurs, as evidenced by trash entangled in trees and bushes 3 to 4 feet above the normal stream level.

The topography of the surrounding area of Chattanooga Creek is rough and mountainous, promoting a special susceptibility of the stream to overflow due to heavy, short duration, spring and summer storms. Floodplain development is considered to be heavy in the Chattanooga Creek basin. Backwater from severe Tennessee River floods could extend up the entire length of Chattanooga Creek. Headwater flooding prevails along Chattanooga Creek but has not been a major problem. In the past, Tennessee River backwater has caused heavy flood damage to the highly developed floodplain. The ST Site, Chattanooga Creek Tar Deposit, and a small portion (less than 1 acre) of the coke production facility are all located within the 100-year flood plain.

1.3.7 ECOLOGY

1.3.7.1 <u>Sensitive and Unusual Habitats or Ecosystems</u>

The riparian and wetland habitat/ecosystem of Chattanooga Creek forms an important greenway through the city of Chattanooga. This stream is particularly valuable for overwintering migratory waterfowl. The many functions and values associated with the wetlands of Chattanooga Creek are valuable in this urban setting due to the extensive industrial and metropolitan development (U.S. Army Corps of Engineers 1995).

1.3.7.2 <u>Aquatic Habitat</u>

Aquatic habitat in the project area includes Chattanooga Creek and its associated oxbows, beaver ponds, excavated borrow pits and riparian forested areas that are seasonally flooded.

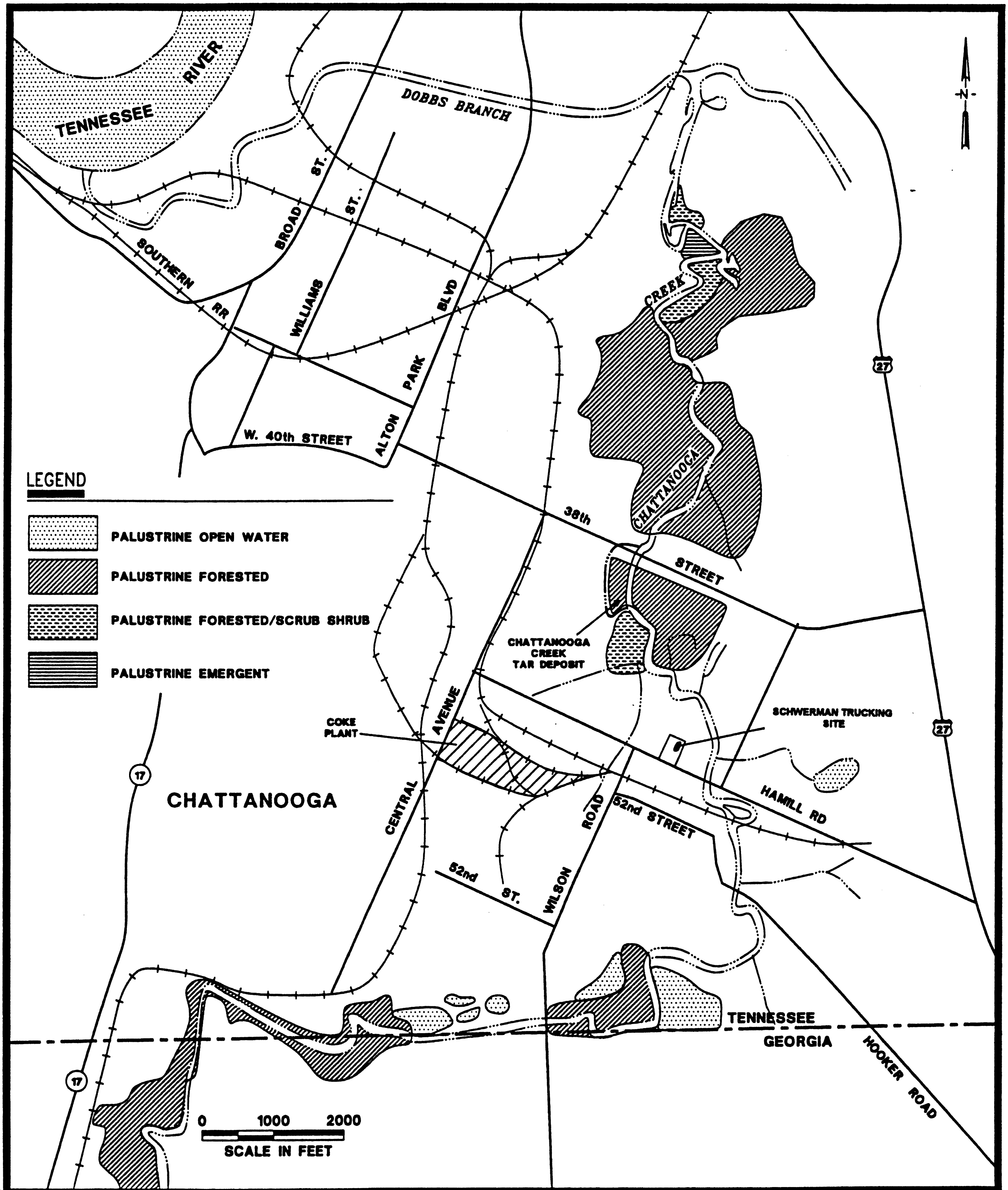
Chattanooga Creek possesses a fairly diverse habitat which includes logs, snags, bank overhangs, pools and riffles located upstream of the 38th Street Bridge. Below the 38th Street Bridge, and especially from Dobbs Branch downstream, the creek has less habitat diversity where channelization has occurred. Additionally, these waters exhibit low dissolved oxygen and can be anaerobic due to the biological oxygen demand from the sewage and wastes carried by the numerous storm sewers and outfalls that empty into this reach. In this section, the main stream channel is the primary habitat type and there are few snags, no riffles and no bank overhangs. Also, the stream flow is diminished and the substrate has changed from the rubble, gravel and coarse sand substrate that is visible in the upstream reaches. The creek bed is characterized by a silty and organic laden substrate in the downstream reaches below 38th Street. Substrate is an important factor in determining the composition of the macroinvertebrate fauna since the coarser substrates are preferred by benthic fauna. Silts not only impact the fish community by elimination of spawning areas, but also by decreasing their food supply of benthic macroinvertebrates. Chattanooga Creek is classified for "Fish and Aquatic Life" from its mouth to the state line. Under water quality criteria rules for the Tennessee Department of Environment and Conservation (September 1991), for "Fish and Aquatic Life" classification, "bottom deposits or sludge banks of such size or character that may be detrimental to fish and aquatic life" are prohibited. It is evident from biological studies that disruption of the fauna has occurred and is continuing to occur in the lower reaches of Chattanooga Creek and that the impacts have affected the balance of the aquatic community and retarded the attainment of a viable fish and aquatic community.

1.3.7.3 <u>Wetland Habitat</u>

A wetland inventory and classification was conducted by EPA in 1992 on the Tennessee portion of the Chattanooga Creek basin. The wetlands were inventoried and classified according to vegetation, hydrology, and soil type. This field survey characterized and mapped the jurisdictional wetlands associated with the lower reaches of Chattanooga Creek. The results of this inventory are depicted on the wetlands inventory map shown in **Figure 1-12**. It should be noted that this preliminary map is for planning purposes and does not constitute the more exacting jurisdictional delineation.

Overbank flooding of Chattanooga Creek and beaver activity on tributary streams have supported the development of wetland habitats. In addition, there are previously excavated areas along Chattanooga Creek which have subsequently developed into wetland habitat.

The majority of the wetlands are classified as palustrine forested wetlands. However, these forested wetlands vary greatly as to species composition, size and age of overstory trees, and stage of successional development. Early successional forested wetlands adjacent to Chattanooga Creek tend to have lower species diversity in the tree strata as compared with climax areas. Dominant overstory vegetation most prevalent in the early successional forested wetlands include silver maple, green ash, and black willow. The dominant overstory of the late successional forested wetlands includes oak species as well as a wide variety of other species. Wetland areas which were historically borrow pits have developed into a mosaic of open water habitat with wide emergent fringes interspersed around the peripheries. The areas affected by beaver activity have resulted in a mosaic of wetland habitats including emergent, scrub shrub, forested and open water areas. On the average, the indicator status of wetland vegetation along Chattanooga Creek is classified as facultative wetland, which is defined as those species that usually occur in wetlands about 67 to 99 percent of the time, but are occasionally found in non-wetlands.



REGIONAL WETLANDS INVENTORY

CDM FEDERAL PROGRAMS CORPORATION
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Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-12

WETLAND/5may95/1=1

Soils within wetland areas along the creek are characterized as having hydric inclusions and exhibit low chroma matrix colors with high chroma mottle colors. These color characteristics typically develop in soils under hydric conditions.

The hydrology maintaining the bulk of wetlands appears to be influenced primarily by overbank flooding from Chattanooga Creek. Also, since much of the bedrock in this area is composed of limestone, it is likely that the wetland hydrology is supplemented by subsurface seepage through the limestone solution channels.

Forested wetlands are the predominant type of wetlands in the Chattanooga Creek basin. The functions and values of these forested wetlands fall into three categories: community dynamics, physio-chemical processes, and water storage. Community dynamics includes primary productivity, litterfall and decomposition, organic export for food chain support, and significant fish and wildlife habitat. Sediment deposition, retention of nutrients and toxins, and biochemical transformations constitute valuable physio-chemical processes. Bottomland hardwood wetlands function for both surface water and groundwater storage. They serve for the storage of flood flows and help reduce the intensity of flood events. During wet periods these wetlands aid in the recharge of groundwater and augment low flows during dry periods. All of these functions and values are important in an urban setting due to the extensive development in the project area. The Chattanooga Creek corridor also forms an important "greenway" through the city of Chattanooga which is important for overwintering waterfowl that utilize the Tennessee River flyway. Tennessee, in general, has lost 59 percent of its wetlands in the period from 1780 to 1980. This is above the national average of 53 percent. The wetlands located in the lower Chattanooga Creek basin are considered valuable for these reasons.

1.3.7.4 <u>Terrestrial Habitat</u>

Terrestrial riparian habitat in the vicinity of Chattanooga Creek consists of a stream side border of woody vegetation composed of mixed hardwood trees, shrubs, soft- stemmed or herbaceous species and grasses. Trees in various sample areas averaged 40 to 80 feet in height. The riparian forested width varies from a narrow fringe to an approximate 200 yard wide maximum. Undeveloped areas without trees are the result of fields that have become overgrown with grasses, weeds and other herbaceous species.

1.3.7.5 Threatened and Endangered Species

No Federal threatened or endangered species live in, migrate through, or are dependent upon any habitat within the project area.

1.3.7.6 Candidate Endangered Species

No Federal candidate endangered species live in, migrate through, or are dependent on any habitat within the project area.

1.3.7.7 Species of Special Concern

No species of special concern are permanent or seasonal residents, or migrate through the project area.

1.3.7.8 Creek Species Diversity

A diverse array of aquatic organisms could live within the project area; however, the present extent of chemical, wastewater and urban pollution prevents the aquatic species from fully utilizing the habitat. Chattanooga Creek, upstream of 38th Street, presents a diverse benthic population. This aquatic diversity is evidenced by the types of macroinvertebrates inhabiting the stream, adjacent wetlands and riparian environments. EPA investigators observed flies, gnats, mosquitos, midges (Diptera), mayflies (Ephemeroptera), caddis flies (Trichoptera), stone flies (Plecoptera), (Hydroptilidae), dragonflies (Odonata), beetles (Coleptera), crustaceans (Crustacea), planaria (Turbellaria), worms (Oligochaeta), leeches (Hirudinea), snails (Gastropoda) and clams (Corbicula).

This diversity decreases as one progresses downstream from 38th Street until most benthic macroinvertebrates essentially cannot live in the polluted waters in the vicinity of, and below the confluence with Dobbs Creek. Species diversity is also affected by alteration of habitat. Channelization and the formation of a soft silty substrate in Chattanooga Creek below 38th Street also limits species diversity and numbers of organisms.

1.3.7.9 Wildlife

Mammals which are known to be present include raccoon, squirrel, cottontails, opossum, woodchuck, beaver, muskrat and rodent species. Some white-tailed deer are also likely to be present. A few reptiles such as slider turtles and leopard frogs have been observed. No snakes were observed during field surveys conducted at the site, however, they are probably present. Bird life also appeared to be abundant in the area, and although no avian surveys were conducted, blue heron, common species of songbirds such as bluejays, robins, cardinals, grackles, as well as unprotected pest birds such as starlings and sparrows, have been observed.

1.3.7.10 Game Species

The project area is within an urban area and therefore hunting is prohibited. Nevertheless, hunting for small game does occur. Squirrels, rabbits, raccoons, opossums, woodchucks, beaver and muskrat, turtle and frogs are species which could be hunted and eaten.

1.3.8 AIR QUALITY

Ambient air quality in the vicinity of Chattanooga Creek has been a major concern for residents and local environmental agencies for decades. The combination of frequent air inversions and emissions of numerous industries in the area resulted in poor air quality. However, air quality in the area has improved in the last decade. The City of Chattanooga currently meets all federal criteria pollutant standards for the six criteria pollutants (sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulates). Chattanooga has been designated "in attainment" since 1984 for particulates and since 1989 for ozone by EPA. However, offensive odors persist in some parts of the site area, as 30 odor complaints were received from the South Chattanooga area by the Chattanooga Air Pollution Control Board in 1991. The City of Chattanooga is in the process of collecting data to determine if they are "in attainment" under the new air pollution standards. This process typically takes three years, and was started on January 1, 1999.

1.4 SITE HISTORY

1.4.1 ONSITE WASTE PRODUCTION, STORAGE, AND DISPOSAL ACTIVITIES

Coal carbonization removes gases from coal by heating. This process changes coal to coke, which is used for industrial purposes. The off-gases were used for residential heating and lighting. A typical coke oven produces 80% coke, 12% coke-oven gases, 3% coal tar (containing primarily phenols, naphthalene, and other various PAHs), and 1% light oils (such as benzene, toluene, and xylene). The only known regulated hazardous waste generated by the process is a decanter tank tar sludge (waste K087) which contains primarily phenol and naphthalene.

The waste handling procedures used by the plant over it's 69 year history are uncertain. However, uncontrolled dumping of coal tar wastes offsite was apparently a procedure used at one time as is indicated by the discovery of the Chattanooga Creek Tar Deposit, the Hamill Road Dumps. In December 1993, EPA conducted a search for other coal tar waste deposits along the flood plain of Chattanooga Creek between 38th Street and Hooker Road Bridge, on the west side of the creek, but no additional sites were found.

The coke production facility also reportedly used abandoned water supply wells for disposal of wastes from a light oil washer column sometime in the late 1960s and early 1970s. These wastes contained unknown percentages of tar, sulfuric acid, and caustic. The locations of these abandoned water supply wells are unknown.

Although not a direct waste disposal method, numerous discharges of contaminated surface water to the northeast and northwest tributaries have been documented from 1977 until 1990. These tributaries flow from the coke plant and discharge to the creek 1800 feet downstream of the creek's intersection with Hamill Road Bridge. The contaminated surface water contained significant levels of PAHs, phenols, oil and grease, ammonia, and metals. In addition, the coke plant facility reportedly maintained a private sewer line that discharged wastewaters directly to Chattanooga Creek 1 c miles from the plant. This sewer has been documented to exist in the year 1944 and appears on a diagram of the plant from 1967. The sewer was constructed and used by the Chattanooga Coke and Gas Company and the Tennessee Products Corporation which date its existence to at least 1926. The sewer line reportedly terminated at the creek just upstream of the Hamill Road Bridge. Based on the results of geophysical surveying conducted during this remedial investigation, it appears the sewer line still exists beneath both the coke plant and the Velsicol facility. However, instead of discharging directly into Chattanooga Creek, the sewer line appears to have been rerouted such that it now terminates at the Northeast Tributary, just south of the railroad tracks traversing through the middle of the Landes Company Site.

EPA conducted two aerial photographic studies of an area surrounding the Tennessee Products Site. One analysis (EPA 1997a) was to identify potential locations of coal tar deposits in the vicinity of Chattanooga Creek. The purpose of the other analysis (EPA 1997b) was to document past waste disposal activities and other environmentally significant events on and near the coke plant.

Up to 23 aerial photographs spanning a period from 1935 through 1994 were analyzed. The analysis identified suspected disposal areas, impoundments, staining, tanks, debris, coal storage areas, open storage areas, containers and drums, mounded material which may represent waste piles, stacks, probable vegetation damage due to surface run-off from the sites, and discharges to surface drainage pathways.

In general, the aerial photographs showed the nature of the activities onsite. On the Tennessee Products site, the photographs clearly showed coal storage, processing, and loading areas, as well as dark staining on the ground throughout the site.

In addition, several of the aerials showed mounded dark materials on both sides of the railroad at the eastern corner of the site. This area is also in a drainage pathway toward the Northeast Tributary. Open storage and debris piles were also evident in this general area on several aerial photographs. In the 1958 aerial photograph, an area to the south and across the railroad tracks from the mounded material is an area which appears as stressed vegetation. The stressed vegetation area is larger in the 1964 aerial photograph. An oil/water separator was visible on the 1973 aerial photograph and was located on the plant side of the railroad tracks also in this in this area. The installation of an oil/water separator indicates a wastewater discharge. The overflow from this oil water separator would flow northward in a ditch that follows the railroad track. This ditch leads to the Northeast Tributary via a culvert under the railroad tracks. This flow pathway crosses the eastern portion of the Landes property which rom at least 1953 to about 1970 was a low swampy area (EPA 1997b). Later this area appears to have been filled in and used for open storage.

1.4.2 PREVIOUS SITE CHARACTERIZATION STUDIES

1.4.2.1 <u>Coke Plant</u>

Prior to initiation of this remedial investigation, the only significant site characterization study completed was a site investigation of this facility conducted by TDHE in 1990. This investigation included the installation and sampling of four two-well monitor well clusters (MW1 through MW4), the collection of one composite subsurface soil sample at each of the four monitor well cluster locations, and the collection of the following surface soil, sediment, surface water, and waste samples:

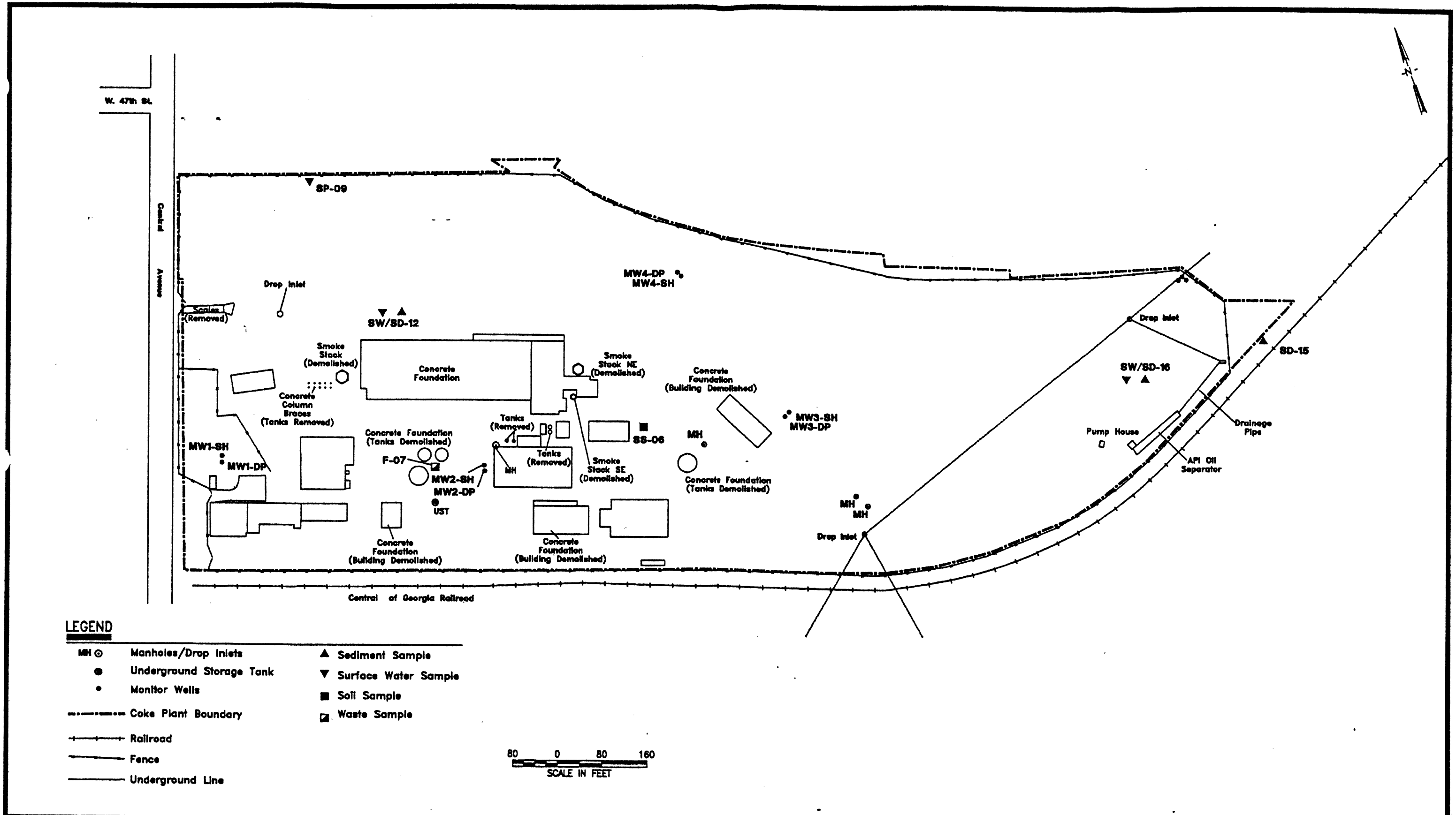
- SP-09 - water from the spring at the northwest outfall
- SS-06 - surface soil from the light oils processing area
- SW/SD-12 - surface water and sediment from the skimmer ditch
- SD-15 - sediment from the Northeast Tributary outfall
- SW/SD-16 - surface water and sediment from the surge pond
- F-07 - waste (black, semi-liquid, tarry ooze) sample from the main plant area

The construction details for the monitor wells are provided in **Table 1-2**, and the locations of the monitor wells and samples are shown in **Figure 1-13**. All samples were analyzed for the full Target Compound List (TCL) and Target Analyte List (TAL) of chemicals, except for SP-09, SW-12, and SW-16 which did not get tested for extractable organic chemicals.

The results of this investigation indicated the following:

- Groundwater is contaminated with a variety of volatile organic chemicals and metals (primarily beryllium, chromium, lead, and mercury). No extractable organics (including PAHs) were detected in any of the groundwater samples.

- Subsurface soils are contaminated with a variety of volatile organic chemicals, PAHs, and possibly metals. Since background concentrations of metals for soils in the area are unknown, it is uncertain whether the metals concentrations measured represent background conditions.



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TDHE 1990 SITE INVESTIGATION
SAMPLE LOCATIONS
Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-13

C 1JUN96/2

- Surface soils are contaminated with volatile organic chemicals, PAHs, phenols, pesticides, and possibly metals. Since background concentrations of metals for soils in the area are unknown, it is uncertain whether the metals concentrations measured represent background conditions.

- Surface waters are relatively clean, although a few low-level volatile organics were detected in the northwest outfall and the surge pond and a few elevated concentrations of metals were detected in the skimmer ditch and the surge pond. As indicated above, however, the surface water samples were not analyzed for extractable organic chemicals.

- Sediments are contaminated with PAHs, phenols, pesticides, and possibly metals. Since background concentrations of metals for the sediments in the area are unknown, it is uncertain whether the metals concentrations measured represent background conditions.

- The one waste sample contained high levels of volatile organic chemicals, PAHs and other extractable organics, and a few metals (primarily arsenic, cadmium, lead).

In December 1995, Mead Corporation completed a "Post-Removal Baseline Assessment" of the coke plant where both soil and groundwater sampling was conducted. A total of 83 soil (40 surface and 43 subsurface), 17 groundwater, and 1 DNAPL samples were collected and analyzed for TCL volatile organic chemicals, TCL semivolatile organic chemicals, and TAL chemicals using EPA Contract Laboratory Program (CLP) protocols. Unfortunately, the results of this investigation were not made available to EPA until the field investigation for this RI was already more than 50% complete. Thus, there was much duplication of effort between Mead Corporation's field investigation and the RI field investigation. However, because the data collected by Mead Corporation appear to be valid and appropriate for a remedial investigation, these data have been incorporated and are discussed in the subsequent sections of this remedial investigation report along with the data collected by CDM Federal as part of the planned remedial investigation.

1.4.2.2 <u>ST Site</u>

No previous sampling of this area has been conducted.

1.4.2.3 Chattanooga Creek Tar Deposit

Sampling of this area has been very limited. In mid-1992, as part of a Chattanooga Creek sediment study, EPA also collected and analyzed a sample of this deposit. The results revealed high levels of volatile organic chemicals, PAHs and other extractable organics, and cyanide.

1.4.2.4 Chattanooga Creek

The waters of Chattanooga Creek have been badly polluted for many years; this was recognized as early as 1937. Pollution primarily stems from raw sewage overflows containing fecal coliforms of over 1000 coliforms per liter, industrial releases of chemicals and metals, chemical pollutants from waste dumps, and non-point sources of urban pollutants. During the 1970s the Tennessee Division of Water Quality Control (TDWQC) made much progress in issuing NPDES permits to companies, thus bringing industrial discharges entering the creek under some environmental control.

In 1973 and 1977, the EPA conducted a number of studies in the area, including two which focused on Chattanooga Creek. The early studies centered on water quality, and did not address the creek sediment. The major sources of contamination were identified, and the wastewater discharges, as well as Chattanooga Creek surface water, were characterized. These early studies included analyses of water for organic compounds.

In 1980, TVA conducted a special survey for toxic priority pollutants which included sediment samples. The findings indicated that much of the creek sediment was contaminated. The discovery of toxic materials in the creek during the TVA study highlighted the need for further data to adequately characterize the creek's water quality, contaminant concentrations in the sediment and aquatic biota. In order to address these data gaps, an aquatic life study was conducted by TDWQC during June 1981; EPA, TVA and TDWQC performed a sediment study of the creek during 1981 and a water quality study was done by TDWQC in July 1982. Results of these studies showed that the worst contamination in the creek occurred between creek mile (cm) 5.06 and cm 2.10. Within this reach lies the tributary that for many years served as a conduit for the coke production facility's wastewater discharges into the creek. A large deposit of PAHs was detected near cm 4.47 at the confluence of the creek and this tributary.

A biological investigation, conducted during 1981 and 1982 by TDHE, focused on the benthic macroinvertebrate community and fish tissue contaminants. Results from this study indicated a relatively diverse benthic fauna was present upstream of 38th Street. The stream reach from 38th Street to just above the confluence with Dobbs Branch had reduced numbers of pollution-sensitive macroinvertebrates when compared to numbers upstream of 38th Street. A severely degraded biological condition exists in Chattanooga Creek downstream of its confluence with Dobbs Branch. Tissue samples collected from turtles, frogs, and fish throughout the creek in this study indicated that PCBs were the most widespread of all the organic pollutants analyzed. Several pesticides (dieldrin, DDT, heptachlor, alpha-BHC and gamma-BHC) were also detected in some tissues.

In 1990, a water quality and sediment study was completed by Dynamac Corporation for EPA on the creek. Additionally, RCRA 3007 information request letters were sent to all facilities located along the creek. Responses to these letters provided some information regarding potential sources of contamination from these industries. Results of the sediment study indicated that the areas previously identified during the 1980s were still contaminated to the same relative degree. It also concluded that PAHs were the most abundant compounds detected, and that general water quality above Dobbs Branch had slightly improved. The improvement can probably be attributed to elimination of wastewater discharges to the creek above Dobbs Branch, and completion of remedial activities conducted at some of the potential source areas of contamination along the stream (see Section 1.4.4). Comparisons of the 1980 and 1990 studies show that contaminant concentrations and stream conditions below Dobbs Branch had not changed. The contribution of untreated raw sewage and industrial waste from the combined sewer overflow structures along this reach continue to negatively impact the creek.

In mid-1992, the Environmental Services Division (ESD) of the EPA, EPA contractors, and the Tennessee Department of Environment and Conservation (TNDEC) collected sediment samples from the state line to the creek's mouth. Following data collection, ESD prepared the Chattanooga Creek Sediment Profile Study Report. The field effort was divided into two phases. Phase I consisted of collecting sixty sediment/soil samples, thirteen water samples and one waste sample. This initial phase of the study indicated that the lower reaches of the creek bed, from the Hamill Road Bridge downstream, are naturally underlain with a heavy clay deposit. This phase of work also substantiated an earlier EPA study which found several isolated areas of large coal tar mounds which apparently had been dumped in the creek bed. The sampling also indicated that creek sediments along the entire length of the site are contaminated with coal tar derivatives. Less widespread but also found in the sediments are VOCs which are indicative of chemical manufacturing/processing contamination. Other contaminants of concern sporadically found in the creek sediments are BTEX compounds, PCBs/pesticides, and metals (primarily chromium, mercury, lead and barium). **Table 1-3** lists all the chemicals measured above detection limits in the sediment samples collected from Hamill Road Bridge to Dobbs Branch, while **Table 1-4** presents a summary of total PAHs, volatile organics, PCBs, and pesticides contamination, and **Table 1-5** presents a summary of the metals contamination found in this section of the creek during this study.

Water samples collected during Phase I of the 1992 sediment study infrequently exhibited contamination and were shown to be nearly as clean as the control sample upstream of the heavily industrialized section of the creek. Downstream of Dobbs Branch where the combined

TABLE 1-3

CHEMICALS MEASURED ABOVE DETECTION LIMITS IN SEDIMENTS COLLECTED FROM HAMILL ROAD BRIDGE TO DOBBS BRANCH TENNESSEE PRODUCTS SITE CHATTANOOGA, TENNESSEE

Extractable Organic Compounds

(3- and/or 4-)methylphenol
(dichlorophenyl)methoxymethylurea
1-methylnaphthalene
1,2,4-trichlorobenzene
2-chloronaphthalene
2-methylnaphthalene
3-nitroaniline
4-chloroaniline
4-nitroaniline
4-nitrophenol
acenaphthene
acenaphthylene
anthracene
benxonaphthofuran
benzo(a)anthracene
benzo(b and/or k)fluoranthene
benzo(ghi)perylene
benzo-a-pyrene
benzoacridine
benzocarbazole
benzochrysene
benzofluoranthene
benzofluorene
benzoic acid
benzoluoranthene
benzonaphthofuran
benzonaphthothiophene
benzophenanthrene
benzopyrene
benzothiophene
benzotriphenylene
binaphthalene
biphenyl
bis(2-ethylhexyl)phthalate
bis(dimethylethyl)methyphenol
bis(dimethylethyl)phenol
carbazole
chrysene
cyclobutaphenanthrene
dibenzo(a,h)anthracene
dibenzoanthracene
dibenzochrysene
dibenzofuran
dibenzopyrene
dibenzothiophene
dichloroethylbenzene
diethylbiphenyl
dihydrodimethlindene
dihydrofluorene
dihydrophenanthrene
dimethyl(phenylmethyl)benzene
dimethylanthracene
dimethylbiphenyl
dimethylethylbenzene
dimethylnaphthalene
dimethylphenanthrene
ethenylidenebis(chlorobenzene)
ethylnaphthalene
fluoranthene
fluorene
hexachlorobenzene
indeno(1,2,3-cd)pyrene
indenopyrene
methyl(phenylmethyl)benzene
methyl(propenyl)benzene
methylanthracene
methylbenaceanthrylene
methylbenzaceanthrylene
methylbenzanthracene
methylbiphenyl
methylcarbazole
methyldibenzofuran
methylfluoranthene
methylfluorene
methylphenanthrene
methylpyrene
methyltriphenylene
N-nitrosodiphenylamine/diphenylamine
naphthalene
naphthochrysene
phenalene
phenanthrene
phenylanthracene
phenylnaphthalene
phenylpentachloroethane
propenylnaphthalene
propylbenzamide
propylnaphthalene
pyrene
terphenyl
thrichloromethylbenzene
trichloro(chloromethyl)benzene
trichlorobenzene
trimethylcyclohexenemethanol
trimethylnaphthalene
[oxybis(methylene)]bisbenzene

TABLE 1-3 (Cont.)

CHEMICALS MEASURED ABOVE DETECTION LIMITS IN SEDIMENTS
COLLECTED FROM HAMILL ROAD BRIDGE TO DOBBS BRANCH
TENNESSEE PRODUCTS SITE
CHATTANOOGA, TENNESSEE

Pesticides/PCBs	Metals	Volatile Organics
Alpha-BHC	Aluminum	Carbon Tetrachloride
Beta-BHC	Arsenic	Benzene
Gamma-BHC	Barium	Toluene
Delta-BHC	Beryllium	Chlorobenzene
Dieldrin	Cadmium	Total Xylenes
Gamma-Chlordane	Calcium	Chloromethylbenzene
4,4'-DDT	Chromium	Ethymethylbenzene
Endrin	Cobalt	Dichlorobenzene
Endosulfan II	Copper	Chloromethylbenzene
PCB-1242	Iron	Ethyl Benzene
PCB-1248	Lead	(Methyethyl)Benzene
PCB-1254	Magnesium	Undecane
PCB-1260	Manganese	Decane
	Mercury	
	Nickel	
	Potassium	
	Selenium	
	Silver	
	Sodium	
	Vanadium	
	Zinc	

TABLE 1-4

TOTAL VOC, PAH, AND PCB/PESTICIDE CONCENTRATIONS IN SEDIMENTS COLLECTED FROM HAMILL ROAD BRIDGE TO DOBBS BRANCH[1]
TENNESSEE PRODUCTS SITE
CHATTANOOGA, TENNESSEE

Distance (ft)[2]	Total VOC Concentrations	Total PCB/Pesticide Concentrations	Total PAH Concentrations
0	1,720,000	ND[3]/56000	1,200,300
600	ND[3]	ND[3]/79	40,030
1,125	ND[3]	ND[3]/86	5,786
1,425	ND[3]	ND[3]/138	18,315
1,800	726	ND[3]/ND[3]	20,717,000
2,400	10	ND[3]/234	100,840
2,775	74,600	ND[3]/NA[4]	66,515,000
2,775	ND[3]	ND[3]/9360	45,472
3,150	49,500	ND[3]/ND[3]	23,715,000
4,350	ND[3]	ND[3]/999	208,540
5,550	ND[3]	190/ND[3]	529,800
7,050	ND[3]	1820/ND[3]	1,781,000
7,650	62	1210/ND[3]	602,300
8,850	130	15200/ND[3]	754,000
10,050	ND[3]	1520/ND[3]	3,283,000
11,250	ND[3]	380/ND[3]	968,900
12,150	ND[3]	520/ND[3]	109,300

1 All values were obtained from the 1992 EPA Stream Profile Study (Concentrations are in ug/kg)
2 Distances are approximations from sampling point 009-SD which is located approximately 200 feet upstream (south) of Hamill Bridge.
3 ND = Not Detected
4 NA = Not Analyzed

TABLE 1-5

SUMMARY OF METALS ANALYSES FOR SEDIMENT SAMPLES COLLECTED FROM HAMILL ROAD BRIDGE TO DOBBS BRANCH[1] TENNESSEE PRODUCTS SITE CHATTANOOGA, TENNESSEE

Metal	Average Background Concentration[2]	Maximum Concentration	Minimum Concentration	Average Concentration	Detection Frequency
ALUMINUM	3000.0	57000.0	2200.0	14668.8	32/32
ARSENIC	6.2	40.0	3.8	9.1	32/32
BARIUM	24.0	170.0	27.0	104.4	32/32
BERYLLIUM	ND[3]	2.6	ND[3]	0.2	3/32
CADMIUM	ND[3]	2.4	ND[3]	0.1	1/32
CALCIUM	803.0	5000.0	920.0	2625.6	32/32
CHROMIUM	18.3	280.0	19.0	99.3	32/32
COBALT	5.5	23.0	ND[3]	13.6	31/32
COPPER	5.5	200.0	6.6	44.3	32/32
IRON	12666.0	46000.0	3100.0	20225.0	32/32
LEAD	8.0	230.0	9.7	78.3	32/32
MAGNESIUM	242.0	2400.0	210.0	1143.8	32/32
MANGANESE	330.0	1700.0	28.0	652.8	32/32
MERCURY	ND[3]	2.0	ND[3]	0.4	24/32
NICKEL	5.3	82.0	7.2	34.4	32/32
POTASSIUM	ND[3]	2900.0	ND[3]	1128.1	22/32
SELENIUM	ND[3]	11.0	ND[3]	0.6	3/32
SILVER	ND[3]	11.0	ND[3]	0.6	3/32
SODIUM	ND[3]	270.0	ND[3]	8.4	1/32
VANADIUM	12.7	54.0	3.9	25.1	32/32
ZINC	29.0	340.0	11.0	176.3	32/32

1 All values were obtained from the 1992 EPA Stream Profile Study (Concentrations are in mg/kg)
2 Average of Three Control Samples
3 ND = Not Detected

outflows continue to discharge into the creek, water quality degrades significantly. Sediment oxygen demand values are high and produce conditions at low flow and high temperatures where the dissolved oxygen levels in the creek are considerably reduced. Water quality parameters such as BOD, nutrients and fecal coliform were not analyzed as part of this study.

Phase II of the 1992 sediment study delineated and quantified the coal tar contaminated creek sediments from Hamill Road Bridge to Dobbs Branch. During this field effort cross sections were set up at intervals along this reach and core samples taken down to natural alluvial materials. This enabled the EPA to get a profile of the creek bed and extrapolate volumes of material which needed to be removed. The estimate derived from these studies predicted that 14,500 cubic yards of material would need to be removed.

In 1992, EPA also conducted an ecological assessment of the creek. Following data collection, EPA prepared the Ecological Assessment of Chattanooga Creek Report. The findings in EPA's 1992 study were similar to those found in TDHE's 1981 to 1982 study. A benthic macroinvertebrate survey conducted as part of this study indicated that the reach of Chattanooga Creek, from its source to the confluence of Dobbs Branch, has more diverse community than the lower reach of the creek. No pollution-sensitive macroinvertebrates were collected below this confluence. Macroinvertebrates collected from Dobbs Branch also gave indications that it was severely degraded. Sediment samples collected from these degraded reaches were dominated by a pollution-tolerant family of aquatic worms. Stream degradation was determined to be caused by habitat alteration, combined sewer overflows, and non-point source impacts from sediments and sediment-borne pollutants.

EPA's 1992 ecological assessment also indicated that Chattanooga Creek has a sparse population of fish which were almost non-existent in lower reaches at the time of collection. Fish were extremely difficult to obtain because of their scarcity and site accessibility problems. Almost all fish tissue analyzed contained pesticides and PCBs in detectable concentrations. Dieldrin, DDE and PCB-1254 were the most common contaminants. These contaminants and others were also present in fish collected from Chattanooga Creek near the Tennessee-Georgia state line. A Fish Health Assessment Index (FHAI) was determined on largemouth bass at only one station which was centered at Dobbs Branch. A minimum of seven fish of the same species were used to conduct the assessment. This location was the only station where this criterion was met. The FHAI indicated the largemouth bass collected were in below average health.

Freshwater asiatic clams (Corbicula spp.), which are abundant throughout the Chattanooga Creek, were also collected from three locations during this 1992 ecological study. One location was upstream of an area known to be contaminated with polynuclear aromatic hydrocarbons (PAHs) and two stations were located within the contaminated reach. The clam tissue collected upstream of Wilson Street contained no PAHs or PCBs in detectable amounts. Clams collected from the two stations downstream of 38th Street, near Alton Park School, contained PAHs and PCBs. No pesticides were detected in any of the clam tissue. These data results indicate that the clam tissue bioaccumulates some of the contaminants found in the sediment of Chattanooga Creek. In addition, visible evidence collected indicated that these small clams are being readily consumed by raccoons and other animals. EPA is currently collecting and analyzing additional ecological samples and data to perform an Ecological Risk Assessment for the creek.

1.4.3 OTHER RELATED SITE INVESTIGATIONS

1.4.3.1 Velsicol Chemical Corporation

A RCRA Facility Assessment was initiated at the Velsicol Chemical Corporation Site (including the former Reilly Tar property) by EPA in 1988. From this assessment (and subsequent investigations) a total of 70 Solid Waste Management Units (SWMUs) were identified at the site, of which 40 were determined by EPA to require no further action and 6 were to be addressed under RCRA closure. RCRA Facility Investigations (RFIs) were recommended for the remaining 24 SWMUs.

A Phase I RFI was initiated by Velsicol in 1993 and completed in 1994. During this investigation, several monitor well clusters were installed and numerous groundwater, surface water, soil, and sediment samples were collected. The results of this Phase I RFI indicate the following:

- Contamination of soils, sediments, surface water, and groundwater is widespread at this facility. Contaminants of concern include volatile organic chemicals, extractable organic chemicals, pesticides/herbicides, and a few metals.
- Groundwater contamination from various sources is likely commingled.
- Coal tar DNAPLs are present in the fractured rock at the top of the fresh rock zone in the former Reilly Tar area.

Velsicol is currently conducting interim measures at their facility primarily to address the soil and DNAPL contamination at the former Reilly Tar facility, and to prevent any further offsite contaminant migration in groundwater. As part of these interim measures, additional monitor wells were constructed at the facility. **Table 1-6** presents the construction details for all monitor wells currently located at the Velsicol site while **Figure 1-14** shows the locations of these monitor wells. Velsicol has conducted a dye tracer study to assist in characterizing groundwater flow in the bedrock formation beneath the site and to assess basin-wide discharge points for groundwater exiting the Velsicol facility. The investigation found no evidence of mature karst systems. Groundwater flow within the carbonate rocks beneath the site is dominated by laminar diffuse flow, although a small component of turbulent flow through conduits is also present. Monitoring wells can be used to monitor groundwater flowing in the laminar diffuse flow portion of the aquifer and springs can be used to monitor the conduit flow portions. The direction of groundwater flow as determined based on potentiometric maps, is supported by the dye trace data.

TABLE 1-6

EXISITING OFFSITE MONITOR WELL CONSTRUCTION DETAILS
TENNESSEE PRODUCTS SITE
CHATTANOOGA, TENNESSEE

Well ID	Date Constructed	Construction Material	Borehole Depth *(feet)*	Casing Depth *(feet)*	Screen Length *(feet)*	Ground Elevation *(feet msl)*	TOC Elevation *(feet msl)*
Velsicol Chemical Company:							
VC10	09/23/93	PVC	19.5	9	10	689.7	692.11
VC11	10/19/93	PVC	34.0	29	5	690.9	692.33
VC12	09/28/93	PVC	26.5	11	10	675.4	678.04
VC13	10/22/93	PVC	62.0	42	10	675.9	678.34
VC14	10/15/93	PVC	20.0	7	10	671.8	674.29
VC15	10/18/93	PVC	42.0	32	10[1]	672.2	674.51
VC16	09/23/93	PVC	20.8	8	10	678.7	680.98
VC17	10/21/93	PVC	40.0	28	5	679.1	682.11
VC18	09/27/93	PVC	20.0	5	10	679.9	682.44
VC19	10/15/93	PVC	55.0	45	10	679.7	682.20
VC20	09/23/93	PVC	31.5	10	10	678.3	680.85
VC21	10/21/93	PVC	53.0	40	5	678.2	680.72
VC22	09/28/93	PVC	20.0	9	10	678.7	681.17
VC23	10/19/93	PVC	43.1	38.1	5	679.4	681.18
VC24	09/27/93	PVC	29.5	16.5	10	690.2	692.66
VC25	10/21/93	PVC	66.75	52	10	690.3	692.83
VC26	09/21/93	PVC	17.0	7	10	700.9	703.42
VC27	10/18/93	PVC	36.0	31	5	700.7	703.34
VC28	09/28/93	PVC	25.0	11	10	685.4	687.91
VC29	09/24/93	PVC	30.0	20	10	685.9	688.40
VC30	10/12/93	PVC	33.0	23	10	696.9	699.49
VC31	10/20/93	PVC	55.0	45	10[1]	696.7	699.36
VC32	03/21/95	PVC	12.4	2.4	10	675.3	677.56
VC33	04/03/95	PVC	43.1	22	10	675.5	677.50
VC34	03/21/95	PVC	11.4	1.4	10	663.8	666.14
VC35	03/21/95	PVC	43.0	33	10	664.8	665.64
VC36	03/20/95	PVC	12.5	1	10	674.7	676.47

[1] Open borehole (no well screen used)

Notes: TOC - Top of Casing
--- - Unknown
Depths are measured from ground surface

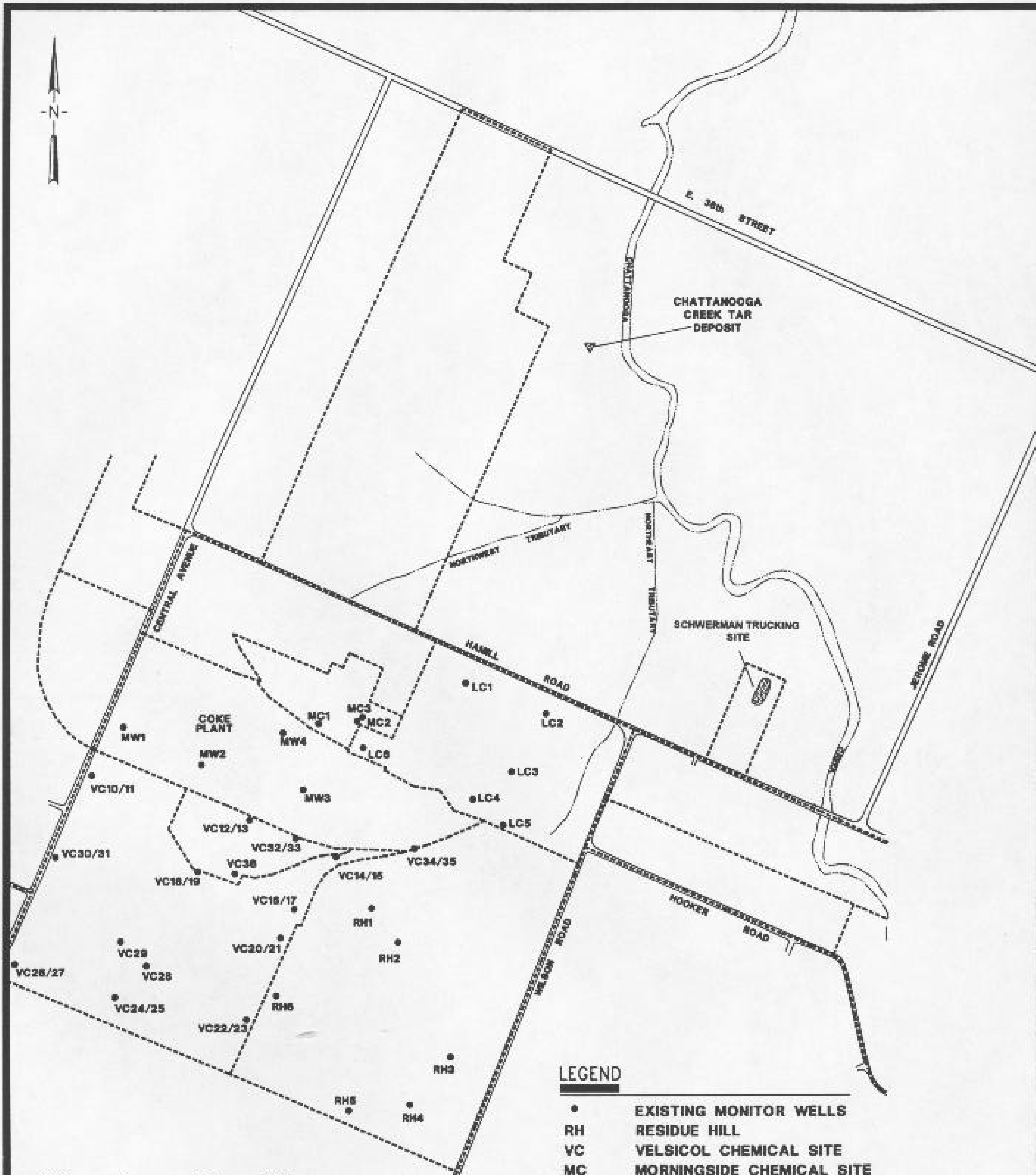
TABLE 1-6 (cont.)

EXISITING OFFSITE MONITOR WELL CONSTRUCTION DETAILS
TENNESSEE PRODUCTS SITE
CHATTANOOGA, TENNESSEE

Well ID	Date Constructed	Construction Material	Borehole Depth *(feet)*	Casing Depth *(feet)*	Screen Length *(feet)*	Ground Elevation *(feet msl)*	TOC Elevation *(feet msl)*
Residue Hill:							
RH1	---	---	52.4	---	---	678.4	683.54
RH2	---	---	44.0	---	---	670.5	674.26
RH3	---	---	43.3	---	---	667.8	668.84
RH4	---	---	42.3	---	---	668.7	672.91
RH5	---	---	61.4	---	---	680.3	685.16
RH6	---	---	55.9	---	---	678.7	680.83
Landes Company Site:							
LC1	10/11/90	PVC	19.0	9	10	---	---
LC2	10/11/90	PVC	19.5	9.5	10	653.6	655.97
LC3	10/11/90	PVC	15.0	5	10	---	---
LC4	10/11/90	PVC	15.0	5	10	---	---
LC5	10/11/90	PVC	23.7	13.7	10	659.6	662.04
LC6	10/11/90	PVC	15.0	5	10	---	---
Morningside Chemical Company Site:							
MC1	09/11/89	PVC	21.75	---	10	663.4	665.47
MC2	09/12/89	PVC	15.0	---	10	---	---
MC3	09/13/89	PVC	18.0	---	15	659.6	661.80

[1] Open borehole (no well screen used)

Notes: TOC - Top of Casing
--- - Unknown
Depths are measured from ground surface



PRE-REMEDIAL INVESTIGATION
MONITOR WELL LOCATIONS

Tennessee Products Site
Chattanooga, Tennessee

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE No. 1-14

PR_R_INV/14JUN96/800

Residue Hill has been sampled extensively over the past two decades. In fact, the groundwater under the Residue Hill cap has been monitored quarterly since the cap's completion. Table 1-6 and Figure 1-14 presents the construction details and locations of monitor wells in and around the Tennessee Products site. The groundwater analyses, however, have included only a few hazardous chemicals. The most recent investigation conducted at Residue Hill was a site inspection conducted by EPA in 1992. Surface soil, sediment, surface water, and groundwater samples were collected both onsite and offsite during this investigation and analyzed for all TCL and TAL chemicals. The results of this investigation indicated the following:

- Groundwater downgradient of the site is contaminated primarily with volatile and extractable organic chemicals.
- While surface waters (a seep north of the site) appear to be contaminated primarily with phenols, sediments appear to be contaminated primarily with pesticides.
- Soils appear to be contaminated primarily with PAHs and pesticides.
- It is uncertain whether the source of any of this contamination is Residue Hill, due to the potential for other industries in the area to have caused this contamination.

1.4.3.2 Landes Company Site

An environmental assessment of the Landes Company site was conducted by a potentially responsible party (PRP) in 1990. Surface and subsurface soil samples were collected, and shallow groundwater samples were collected from six monitor wells constructed onsite. The construction details for these monitor wells are provided in Table 1-6 and their locations are shown in Figure 1-14. The analytical results for these samples showed the presence of both organic and inorganic contaminants.

A site investigation of the facility was conducted by TDHE in 1994. This site investigation addressed primarily the dump area located in the southeastern corner of the site. A total of 15 soil, sediment, and waste samples were collected during this investigation. No groundwater or surface water samples were collected. Both the waste sample results and the soil/sediment sample results showed significant concentrations of PAHs, pesticides, metals, and cyanide.

In August, 1996 during construction of a new warehouse on the Landes property, subsurface contamination was uncovered and believed to be related to coal tar. CDM Federal collected samples of soil, surface water, and waste to characterize the contamination. The analytical results of these samples are discussed in Sections 5 and 6 of this report.

1.4.3.3 <u>Morningside Chemical Company Site</u>

In 1985 TDHE conducted a site inspection of the Morningside chemical property. Sampling and analysis of liquid and sludge collected from the basement indicated the presence of significant concentrations of volatile organics, extractable organics, and heavy metals. Sampling and analysis of a surface soil sample from the trench area indicated the presence of naphthalene and various heavy metals.

A 1989 site investigation by TDHE primarily addressed three areas: waste in the trench, subsurface soil away from the trench, and shallow groundwater. Waste and soil samples were collected from and around the trench, and groundwater samples were collected from three shallow monitor wells constructed onsite. The construction details for these monitor wells are provided in Table 1-6 and their locations are shown in Figure 1-14.

The results of this investigation indicated that the waste materials and soils around the trench were contaminated primarily with volatile organic chemicals, PAHs, and heavy metals (chromium, copper, and zinc). However, the only significant groundwater contamination found at the site was in the upgradient monitor well where high concentrations of volatile organic chemicals were measured.

In 1997 TDHE discovered over 900 drums stored inside a warehouse on the property. Some of the drums were in poor condition and were leaking.

1.4.4 PREVIOUS REMOVAL ACTIONS IN THE PROJECT AREA

In an effort to remediate the study area, control the migration of site contaminants and provide protection for local citizens, EPA and TDHE have initiated several removal actions. Below is a list and a short description of each action.

- In the summer of 1985 EPA excavated approximately 1000 tons of waste and contaminated soil from Hamill Road Dump #3. This removal action was financed by Superfund. This site is about one acre in size and is bisected by the Northeast Tributary to Chattanooga Creek. During sampling of an alleged wastewater discharge, TDWQC found, and subsequently sampled, the site. Laboratory results indicated high levels of PAHs. Once the contaminated soils were excavated, the area was backfilled with clean material and capped by the city's Public Works Department. Due to its proximity to the tributary, heavy precipitation events still affect the area. The area is not fenced.

- In the fall of 1986 Southern Railway, under the oversight of TDHE, cleared and capped the Hamill Road Dump #1. Hamill Road Dump #1, approximately three-quarters of an acre in size, is located on the banks of the creek at the intersection of Hamill and Jerome Roads. Previous sampling had detected PAHs, pesticides, and elevated levels of cadmium and lead. Geonet and riprap were placed at the toe of the dump's slope, on the banks of the creek. A fence is maintained along the road; however, none exists on the side near the creek.

- In June 1991 TDHE requested its Emergency Response contractor to overpack some hazardous waste containers at the Landes Company Site. The site is located between the Piney Woods and Alton Park neighborhoods. Companies operating on this property over the years have specialized in metal fabrication and the manufacturing of concrete forms. It has also recently been used by an associated company to store waste. Hazardous substances which were removed included hydraulic and petroleum oils, paint wastes, adhesives, ammonium hydroxide and petroleum naphtha. Some of the overpacks remain on-site.

- In October 1993, EPA installed security fencing around the Chattanooga Creek Tar Deposit and on the eastern side of Alton Park Junior High School adjacent to

Chattanooga Creek, as a deterrent to prevent children from being exposed to coal tar waste deposits located in these areas.

- In December of 1994, the Mead Corporation, which operated the Coke and Chemical Plant from 1968 to 1974, demolished all remaining site structures. In addition to demolishing the coke ovens and stacks, and properly disposing of the debris, the company removed all asbestos from the structures. After demolition, Mead repaired and replaced the existing fence and gate, and posted warning signs. Several monitor wells were installed at the coke plant and sampled as part of this removal action. The number, locations, and construction details of these monitor wells are unknown as are the sampling results.

- Shortly after Velsicol purchased the Reilly Tar property, it was discovered that Reilly Tar tanks and equipment left onsite contained residual heels of tar and coal tar sludge and water. The equipment was cleaned and removed to Reilly Tar. It also became apparent that 3 concrete pits located onsite contained 1 to 2 feet of coal tar and 8 to 9 feet of rainwater and soluble coal tars. The estimated volume of liquids was 300,000 to 400,000 gallons and the estimated volume of solids was 150,000. In 1986, these wastes were removed with some of the wastes being recovered by Reilly Tar at another facility and some being disposed of at GSX's Pinewood, South Carolina, landfill. The pits were also cleaned and filled, and a clay cap was constructed over the tar pit area.

- In 1988, a PRP for the Morningside Chemical Company Site removed the contaminated materials from the basement and a concrete vault located onsite, and decontaminated the floors and walls of the basement and vault. The excavation and treatment of the trench materials and contaminated soils at this site was completed in 1995. The trenches were backfilled with clean material and capped with clay. In 1997 USEPA solidified and removed the contents of the leaky drums found in the warehouse.

1.4.4.1 <u>Non-Time-Critical Removal</u>

In 1997 and 1998 IT Corporation (IT) conducted a Non-Time Critical Removal Action to remove coal tar deposits from Chattanooga Creek, tar deposits in the floodplain (the Chattanooga Creek tar deposit, a tar pit known as the “south pit” (see Figure 1-1)) and waste piles located on the TP plant site. The work was performed under the direction of the U.S. Environmental Protection Agency (USEPA) Region IV and the U.S. Army Corps of Engineers (USACE) Omaha District and Nashville District offices.

Removal of tar deposits from the creek bed required delineation of the deposits in the creek, clearing and grubbing along the creek, construction of access roads, diversion of the creek, excavation of the overlying sediments, excavation of the waste material, and restoration of the creek.

About 22,935 cubic yards of material was excavated from 4,236 linear feet of the creek. Excavation north of the E. 38th Street bridge encountered coal tar deposits up to a maximum depth of 16 feet under two feet of overburden. In addition, 165 cubic yards of material was excavated from the Chattanooga Creek tar deposit in the floodplain of the creek, and 250 cubic yards were excavated from the south pit.

In addition to the material removed from the creek and its floodplain, approximately 2,000 cubic yards of mounded material were removed from the western and rear part of the plant site. The material consisted of coal tar intermixed with large pieces of slag, coal fines, and other detritus. This dry, low BTU, material was used to process the wetter material excavated from the creek area prior to off-site shipment.

At the plant site, the material excavated from the creek was physically worked to allow proper mixing and drying prior to shipping off-site. The subcontractor mixed inert material such as sawdust, ground corn cob, coke breeze/coal, and previously removed coal tar mound material to assist in drying the excavated Creek coal tar and to increase BTU value of the processed material. On a regular basis, processed coal tar material was transported off-site. All processed coal tar material was shipped to facilities where it was used as fuel. These facilities including the cement kiln at the Giant Resource Recovery facility in South Carolina, the boiler at the Illinova Power facility in Baldwin, Illinois, and the cement kiln at the Global Stone facility in Tennessee. In addition, numerous tires removed from the creek were shipped to a Chattanooga facility that burned the tires for fuel. Other materials removed from the creek sediments and waste were disposed at a local landfill.

In June, 1998, unidentified odors from the piles of overburden sediments staged on the Creek bank, were detected and reported to the USACE and USEPA. Analytical results indicated elevated levels of various herbicide and pesticide compounds in the sediments. Initial evaluation of the analytical results indicated that the elevated levels were generally confined to Creek sediments from approximately 1500 feet to 2300 feet north of the Hamill Road bridge. Subsequent samples collected for toxicity leachate characteristic potential (TCLP) analysis indicated the overburden sediment to be RCRA non-hazardous. Approximately 1,150 cubic yards of sediments were removed and disposed of at a local municipal landfill.

1.5 NATURE OF THE SEDIMENT CONTAMINATION IN CHATTANOOGA CREEK

As indicated above, prior to initiation of this remedial investigation, very limited sampling had been conducted at the ST Site and Chattanooga Creek Tar Deposit areas, and data from sampling conducted by the Mead Corporation at the coke plant were not yet available to EPA. Therefore, the nature and extent of the contamination in these areas, although partially defined, were not fully delineated. However, Chattanooga Creek has been sampled extensively during the past two decades, and the nature and extent of contamination associated with this area, for the most part, was defined prior to initiation of this RI. To indicate the nature of the problem at the Tennessee Products Site, the sections below briefly describe the known nature and extent of contamination associated with the Chattanooga Creek sediments.

1.5.1 TYPES OF CONTAMINANTS

Results of studies by TVA in 1980, TDHE in 1983, and EPA in 1990 and 1992, have shown that the area along Chattanooga Creek is heavily contaminated with coal tars and coal tar products, wood tars and wood tar products, coke and coke products, and by-products and residues from several industrial operations. Many coking facilities, chemical plants, smelting and foundry works, and several dumps and landfills are located along the creek.

The sediments in the creek and some soils along the banks are contaminated with chemicals and coal tars which generally are products of the wood preserving and coking industries. In the coking process one ton of coal produces 1200-1500 lbs. of coke and 70-120 lbs. of coal tar. The coal tar normally contains 50-85 percent pitch, and the rest consists of naphthalene, creosote and anthracene. Pitch is mostly a large variety of long chain hydrocarbons along with small percentage of various PAHs. The higher the molecular weight, the more viscous the material. The pitch is used in the paving and coating industry and the other components are used in wood preserving and refined into oils, drugs and other chemicals.

The classes of compounds found in the stream are: polynuclear aromatic hydrocarbons (PAHs), chlorinated solvents, organic solvents, other chlorinated and related compounds (including pesticides and PCBs), metals, and phenols. The PAHs, other chlorinated compounds and phenols are from the semi-volatile group of compounds, while most of the organic and chlorinated solvents are volatile compounds. PAHs were found in every sample collected north of Hamill Bridge to Dobbs Branch, ranging from 810 ppb to greater than 20,000,000 ppb total PAH. Pesticides and PCBs were found in 26 of the 32 samples collected. The pesticides ranged in concentrations from not detected to 51,000 ppb for Alpha-BHC near Hamill Bridge. PCBs ranged from not detected to 12,000 ppb in the sediment near Southern Wood Piedmont. Volatile organic compounds were found in only nine of thirty-two samples and ranged from not detected to 1,760,000 ppb total VOCs near Hamill Bridge. All of these compounds are associated with the thick, black material found in the soil and sediments.

Coal tars and pitches are generally not very soluble in water, and their movement through the environment by water may be due to mechanical action. The coal tars in the creek are believed to have resulted from years of disposal of process liquids/sludges and surface run-off into the creek via drainage ditches from the production facilities and from probable direct disposal events.

Many of the compounds found are natural coal tar constituents, while others are chemicals that mix readily with the coal tar and ash. Detected chlorinated compounds probably dissolved into the tars and were retained. The 1992 EPA study found low concentrations of pesticides and PCBs that had not been found previously. While pesticides and PCBs were found intermittently along the area of concern, the higher concentrations were invariably found in areas with high concentrations of coal tar. Hardened pitch is likely to have encapsulated many solvents and other chemicals of concern.

The consistency of the material varies from hard asphalt-like material to a sludge. Experience with similar contaminants at creosote operations shows that the less viscous tars and sludges will migrate through sediments through opportunistic pathways such as roots, sticks, and other debris. This presents the possibility of contamination at several levels, with contamination moving from an upper layer to a lower sediment layer or radiating out along root paths.

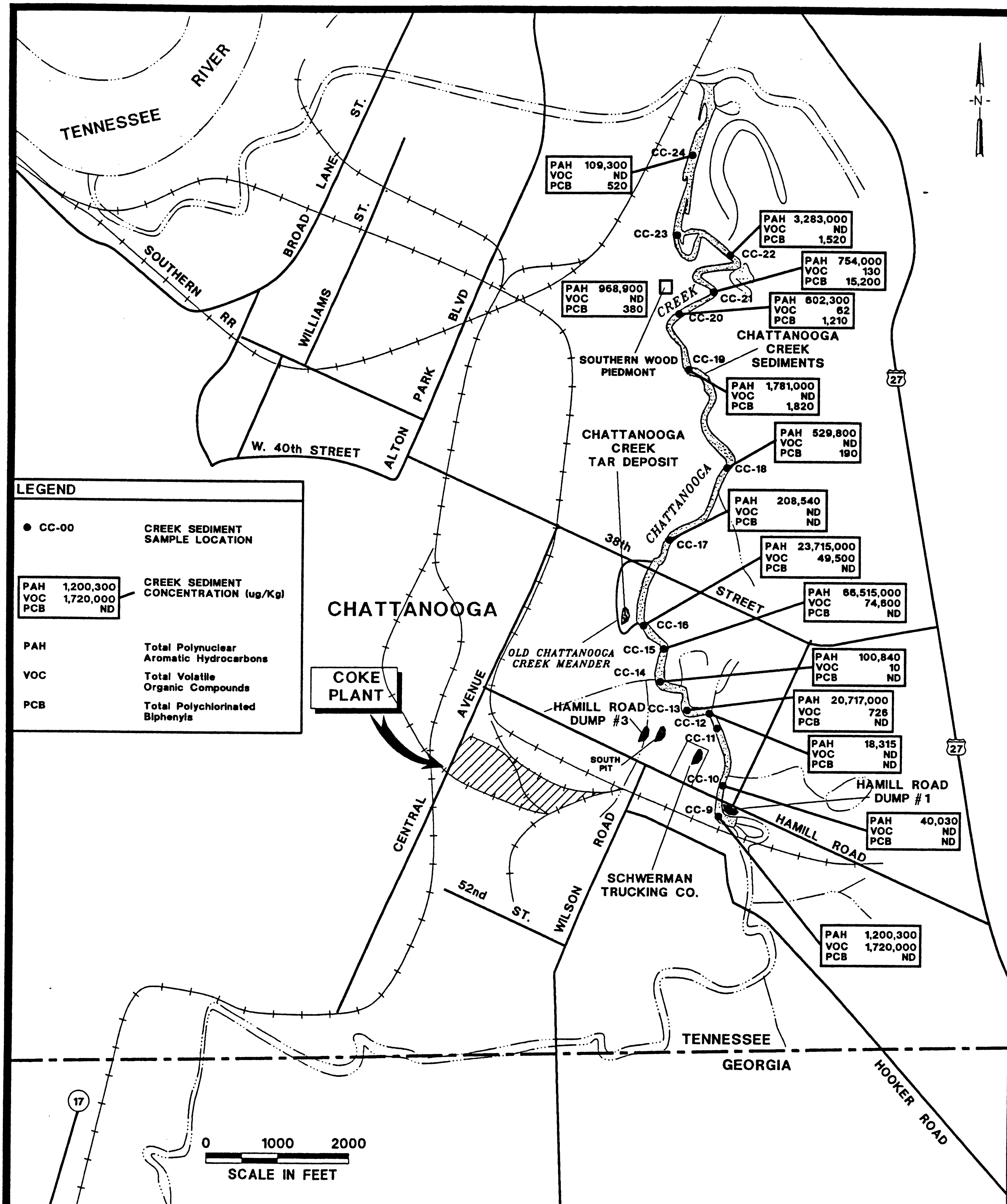
In the 1992 EPA Sediment Profile Study, twenty-four different metals and low levels of cyanide were found in the creek sediment. Twenty-one metals and cyanide were found in the stretch of creek from Hamill Road Bridge to Dobbs Branch. Of these, 16 metals were found twenty-two to thirty-two times out of thirty-two samples. Beryllium, selenium, and silver were found only three times out of thirty-two samples, and cadmium and sodium were detected only once each. Assessing frequency, concentration, and the background values established in the study, it would appear that several metals are above background. Specifically, aluminum, barium, chromium, copper, lead, magnesium, mercury, potassium and zinc are significantly above background levels. While metals are no doubt present as natural constituents of the sediments, elevated levels must be considered indicative of contamination. Iron, while not significantly above background, is still a major analyte in the sediment. Metals will absorb/desorb from normal sediments with changes in pH and the concentration of other metals in the immediate area. Iron, aluminum, and manganese in particular, will form colloids with other metals and will facilitate the transport of those metals.

1.5.2 EXTENT OF CONTAMINATION

Practically speaking, the entire stream bed from the Hamill Road Bridge to Dobbs Branch is heavily contaminated with coal tar compounds which range in depth from one inch to greater than eighteen inches. The distribution of PAH, VOCs and PCBs is Chattanooga Creek sediments at the time of the 1992 study is shown in **Figure 1-15**. The coal tar contamination is confined to the stream beds and banks of Chattanooga Creek, with the exception of areas where the stream bed has moved, such as the filled-in oxbow on the west bank, downstream of Hamill Bridge. No significant coal tar contamination has been found in the surface waters of the creek, however.

There are also several distinctive shoals of tar-like material that were likely deposited either directly into the creek or on the bank with a subsequent entry into the creek. The maximum thickness of tar encountered during the Non-Time Critical Removal was 16 feet (under two feet of overburden).

During Phase II of the Sediment Profile Study, which was intended to define the extent of the contamination, coring devices were advanced to refusal and the cores extruded and visually examined. Obvious contamination was present at almost every cross section and varied in depth from the surface to more than a foot below the surface. While the core samples were collected in a methodical pattern, which developed a reasonable estimate for the horizontal



CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

PRE-REMEDIAL DISTRIBUTION OF PAH, VOCs, AND PCB IN CHATTANOOGA CREEK SEDIMENTS

Tennessee Products Site
Chattanooga, Tennessee

FIGURE No. 1-15

regloc/18FEB99/1=1

extent of contamination, the vertical extent was evaluated solely on the visual aspect of the sample.

1.6 RI FIELD INVESTIGATION SUMMARY

The primary objective of the RI was to provide the additional data needed to adequately support a baseline human health risk assessment and provide a basis on which to recommend an appropriate remedy. During the RI, specific data requirements were addressed. These include better definition of the following:

- The nature and extent of waste deposits at the Schwerman Trucking Site and Chattanooga Creek Tar Deposit source areas
- Background concentrations of chemicals in soil and groundwater
- The nature and extent of soils contamination at the coke plant, Schwerman Trucking Site, and Chattanooga Creek Tar Deposit source areas
- The nature and extent of surface water and sediment contamination in the Northeast and Northwest Tributaries, and the surface water impoundments located at the coke plant
- The nature of sediment contamination in Chattanooga Creek (i.e., any dioxin/furan contamination)
- The nature of air contamination currently being emitted from the coke plant and Schwerman Trucking Site source areas
- The nature and extent of groundwater contamination emanating from each of the four source areas
- The nature and extent of coal tar DNAPLs beneath the coke plant, Schwerman Trucking Site, and Chattanooga Creek Tar Deposit source areas
- Groundwater flow directions and hydraulic gradients as well as the general groundwater/surface water interaction along Chattanooga Creek

- The aquifer system characteristics including the hydrostratigraphy, hydraulic properties (i.e., hydraulic conductivities), and contaminant transport properties (i.e., distribution coefficients)

- The underground conduits (potential contaminant migration pathways) beneath the coke plant which lead offsite

- The impact of previous and current site contaminant releases on the residential community

The first step in the remedial investigation, after the project plans were developed, was a field investigation. The field investigation included the following tasks:

- Geophysical Surveying - Geophysical surveying of the coke plant area was conducted, using ground penetrating radar (GPR), in an attempt to identify and trace underground conduits leading offsite, particularly toward Chattanooga Creek.

- Air Sampling - A total of high volume (24-hour) air particulate samples were collected from 4 locations onsite (3 at the coke plant and 1 at Schwerman Trucking Site). These samples were sent to a subcontracted laboratory for PAH analyses.

- Waste Sampling - A total of 4 waste material samples were collected from 2 waste deposits onsite (3 from Schwerman Trucking Site and 1 from the Chattanooga Creek Tar Deposit). These samples were sent to a CLP laboratory for complete TCL/TAL analyses. Two of the waste samples were also analyzed for dioxins/furans.

- Soil Sampling - A total of 84 surface soil and 27 subsurface soil samples were collected from various locations on- and offsite. The number of soil samples collected from the various areas are as follows:

Area	# of Surface Soil Samples	# of Subsurface Soil Samples
Background	12	10
Coke Plant	20	17
Schwerman Trucking Site	8	0
Chattanooga Creek Floodplain	18	0
Residential Areas	11	0
Landes Property	5	0
Northeast Tributary	10	0

All the surface soil samples were sent to a CLP laboratory for complete TCL/TAL analyses, except VOCS. Only 22 of the surface soil samples were analyzed for VOCs. In addition, 3 of the surface soil samples collected from the coke plant area were analyzed for dioxins/furans by a CLP laboratory.

All the subsurface soil samples collected from the coke plant area were sent to a CLP laboratory for complete TCL/TAL analyses. All the subsurface soil samples collected from background locations were sent to a CLP laboratory for complete TAL analyses only. In addition, all the subsurface soil samples collected from background locations were split and sent to a subcontracted laboratory for total organic carbon (TOC) analysis.

At Schwerman Trucking Site, 20 surface soil samples were also collected and analyzed for total PAHs onsite using an immunoassay screening technique to help guide the soil sampling investigation conducted for this area.

Five soil samples were collected from the eastern part of the Landes property during construction of a warehouse in 1996. Construction activities had encountered contaminated soil. Three samples were collected from the spoil piles of trenches, and two were collected in areas undisturbed by construction activities. Two waste samples were also collected at this time and are discussed with the soil samples in Section 5.

In December 1996, EPA requested additional soil samples be collected from Northeast Tributary and adjacent spoils piles. The spoils piles resulted from dredging of the Northeast tributary conducted by the city in approximately 1984.

- Surface Water/Sediment Sampling - A total of 21 surface water and 18 sediment samples were collected from various locations onsite. The number of surface water/sediment samples collected from the various surface water features are as follows:

Surface Water Feature	# of Surface Water Samples	# of Sediment Samples
Coke Plant Impoundments	3	3
Northeast Tributary	7	8
Northwest Tributary	7	4
Chattanooga Creek	0	3
Landes Property	4	0

All the surface water/sediment samples collected from the coke plant depressions, Northeast Tributary, Northwest Tributary and Landes property were sent to a CLP laboratory for complete TCL/TAL analyses. All the sediment samples collected from Chattanooga Creek were sent to a CLP laboratory for analysis of dioxins/furans.

- Monitor Well Installation and Groundwater Sampling - A total of 24 new monitor wells (12 soil overburden and 12 upper bedrock) were installed. after proper development of these wells was completed, groundwater samples were collected from each of the 24 newly installed wells, as well as the 8 existing monitor wells installed by the state at the coke plant, the 9 existing monitor wells installed by Mead Corporation at the coke plant, and 10 existing monitor wells installed by Velsicol on their property near the coke plant boundary. All groundwater samples were sent to a CLP laboratory or the EPA Environmental Services Division (ESD) laboratory for complete TCL/TAL analyses.

- Aquifer Testing - In situ horizontal hydraulic conductivity tests of the saturated materials were performed in 23 of the 24 newly installed monitor wells.

- Water Level Measurements - One set of water level measurements was collected. Water levels were measured in the 24 newly installed monitor wells, the 8 existing monitor wells installed by the state at the coke plant, the 9 existing monitor wells installed by Mead Corporation at the coke plant, 2 existing monitor wells installed by the state at the Morningside Chemical Company Site, 2 existing monitor wells installed by the state at the Landes Company Site, and the 27 existing monitor wells installed by Velsicol on their property. Three stream water level measurements and two flow measurements were also collected in Chattanooga Creek on the same day the groundwater level measurements were collected.

Air monitoring was also performed at the site during all field activities for health and safety purposes. Organic vapor measurements of ambient air were taken regularly with a photoionization detector (PID). Generally, the concentrations of organic vapors measured in the breathing zone with the PID were well below action levels. However, at one soil boring location (SB-12), PID readings of up to 6 parts per million (ppm) were measured in the breathing zone. In addition, during drilling through overburden materials at monitor well location (MW1-IN), PID readings of up to 113 ppm were measured in the breathing zone, but generally fluctuated between 1 and 10 ppm. Hence, drilling at these two locations continued in Level C personnel protection.

1.7 OVERVIEW OF REPORT

The remainder of this report contains descriptions and results of the activities performed during the RI. Brief summaries of the remaining sections are presented below:

- Section 2 describes the specific geologic, hydrogeologic, and hydrologic characteristics of the site, as determined from this RI and other area investigations. This section also presents the details of monitor well installation.

- Sections 3, 4, 5, 6, and 7 discuss the results of the air, waste, soil, surface water/sediment, and groundwater sampling investigations, respectively. Each of these sections describes the purpose of the investigation, outlines the methodology for sampling, and summarizes the results of the investigation.

- Section 8 discusses the environmental fate and transport of site-related contaminants.

- Section 9 contains a discussion of the conclusions.